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CONTENTS.

Editorial 1265
The International Telegraph Conference in Lisbon..... 1268
Temporary Shut-Down of Niagara Falls Power..... 1268
Trouble over Chicago Drainage Canal Power..... 1268
Decision of N. Y. Public Service Commission on Consolidation..... 1269
Rates and Contracts of New York Electric Companies..... 1269
Jersey City and Electric Light and Power Franchises..... 1269
Boston Edison Rate Decision by Massachusetts Commission..... 1270
Increase of Power Companies' Valuations..... 1271
New York Central's High-Tension System..... 1271
Niagara Power..... 1271
Electricity at the Franco-British Exhibition..... 1272
Electrical Train Lighting Equipment on the Austrian-Hungarian Government Railroad..... 1273
Bellows-Type Relays for High-Tension Switches..... 1274
Canadian Electrical Association Convention..... 1274
Association of Electrical Engineers of the Iron and Steel Industry.. 1274
Annual Convention of the A. I. E. E..... 1275
Hydro-Electric Development in Mexico..... 1279
Present Status of the Lighting Problem. By Percy H. Thomas..... 1283
Standardization Rules for Stationary Direct-Current Machinery in France, Germany, Great Britain and the United States. By A. E. Kennelly..... 1285
Erection of Transmission Line Towers in Porto Rico. By W. R. Strickland 1288
Accuracy of Electric Meters..... 1289
Letters to the Editors:
Economics of Electric Illuminants. By Alfred A. Wohlauer..... 1290
Looping vs. Cutting Lines of Force. By James Gibbons..... 1290
Rocky Mountain Telephone Strike. By D. S. Murray..... 1290
Digest of Current Electrical Literature..... 1290
Electrical Equipment of the Cargo Fleet Iron Company's Works..... 1296
Italian 12,000-hp Steam Turbo-Generator for Buenos Ayres..... 1299
The Induction-Type Clutch..... 1300
Motor-Driven Eraser..... 1301
Sheet Steel Metal Locker..... 1301
Laminar Choke Coil..... 1301
Gas Fired Insulators for Transmission Lines..... 1302
Switch for Starting Three-Phase Induction Motors..... 1302
Safety "All-in-One" Wireman's Tool..... 1302
Motor Switch Boxes for Use in Mines..... 1303

A. I. E. E. Atlantic City Convention.

The coming convention of the American Institute of Electrical Engineers, to be held at Atlantic City, June 29 to July 2, will be the twenty-fifth general convocation of that body. With on the one hand a desirable meeting place and a season of the year when the call of the seashore is persuasive, and on the other hand a program of papers covering such a wide range of subjects that few members can complain that their specialty has been neglected, the convention promises to be a successful one. Indeed, the number of papers is so large that unless parallel sessions are held there will be little time for the discussion which frequently is of higher value than the paper which draws it forth. During one session, for example, to which three hours are allotted, no less than seven papers are to be presented. Elsewhere a classified list of the papers is printed, together with brief notes indicating their character. As was to be expected in view of relatively recent developments, the subjects of high-tension transmission and electric traction dominate in the program. Electrical apparatus and engineering science are well represented, while engineering education receives the attention which it deserves, particularly at the present time, when it appears to be entering upon a new period of evolution in which professional, technical and industrial education will have distinct courses, instead, as in the past, all phases from general engineering to house wiring, figuring in the same course. To return to the subject of parallel sessions, it would appear that in view of the growing specialization in electrical engineering, it might be wise to endeavor to cover adequately at each annual convention all of the various important departments, and hold on several of the days a number of simultaneous sessions for the separate consideration of papers having a special character, such as those relating to telephony, electric traction, electric transmission, electrochemistry, wireless telegraphy, etc.; the other days being devoted to subjects appealing generally to those in attendance, such as the broader aspects of electrical engineering, principles of engineering science, etc.

The Present Status of the Lightning Problem.

The problem of lightning disturbance, like the problem of the poor, is always with us, and probably always will be in some degree. If it is true that discomfort loves company, then electrical engineers should be comforted by the fact that not they alone suffer by the violence of lightning. According to the statistics collected and published by the Weather Bureau for the year 1899, there were 5527 damaging lightning strokes counted in the United States in these 12 months, injuring 6256 buildings to the money value of over $3,000,000, killing 563 persons, and injuring 820 persons more, besides killing live-

stock in the fields to the total number of 4250. Moreover, lightning damage has been a regular grievance among electrical engineers for more than 70 years, ever since telegraph wires were first placed overhead on poles. Year by year, poles have been destroyed, insulators broken, apparatus burned out. The only electric circuits that have been immune have been buried wires or submarine cables, and even these have naturally ceased to be proof against injury when connected to overhead wires. Electric power-transmission engineers have, however, a harder task than electric telegraph engineers when attempting to follow the example of Ajax, and defying lightning, because they carry their wires higher above ground, insulate them more elaborately, and have to protect their circuits from the dynamo arcs which follow, as well as the lightning discharges which precede. The article by Mr. Percy H. Thomas on page 1283 of this number sums up the causes and effects of lightning disturbance in electric power circuits. It covers, therefore, a wide field and offers many suggestions. As an instance, it briefly reviews the phenomena of summer lightning storms. On a hot day in summer, or on a dog-day in the language of the ancients, who attributed peculiar influence in midsummer to the then existing nocturnal prevalence of the dog-star Sirius, we are apt to predict the onset of lightning storms if the humidity is high. It is to be observed that two essential elements must concur; namely, ample sunshine and abundant moisture. When, with or without moisture, the solar heat applied to the surface is inadequate, as in our winter seasons; or, when there is abundant heat, but insufficient moisture, as over large desert plains in the tropics, there are very few thunderstorms. Where hot weather and solar evaporative power occurs, together with moisture on the surface of the earth to be evaporated, thunderstorms are frequent.

In evaporation, the molecules of water carry away small electric charges or ions, but the molecules are so minute that they fail to constitute a collective charge. By gaseous convection, the steam rises upward. A layer of steam-laden air forms, like oil as Mr. Thomas describes it, under the cooler and dryer layers of the upper atmosphere. The steam-laden air is less diathermanous than the dryer air above, or is more absorptive of radiant heat, so that, as the day advances, the blanket layer of recently evaporated moisture keeps gaining energy from the sunshine it receives, but which it only transmits on a commission basis. The hydrodynamic conditions tend, therefore, to decreasing stability. If a certain critical stage of instability is reached, the oily layer, or lower steam-laden layer, bursts through the overlying cooler and dryer layers, and ascends suddenly to a great height, with the formation of a column of cumulus cloud, due to the condensation of the steam into fog. The condensation provides nuclei for the ions in the upper air to fasten upon, not to speak of those carried up in the steam. Moreover, the potential of the charges rises very rapidly as the condensation proceeds, owing to the great increase in electric surface density as the water particles coalesce. If the electric energy released is sufficient, the electrified cloud will descend toward the earth as a thunder cloud, producing a convective disturbance that releases more of the oily layers to rush up and condense likewise. Thus a regenerative electric system is started that will go on discharging until all the available electricity is released.

Another suggestion in the article is that the voltage required to precipitate a lightning flash from cloud to ground may be less than that necessary to disrupt the entire length of the air column. We know that air, at ordinary temperatures and pressures, has a dielectric strength of about 4 kv per millimeter. At this rate, a column of air 1 km high would require an e.m.f. of 4,000,000 kv, or 4,000,000,000 of volts, to precipitate a flash, and a 1-km flash is rather a short flash from a practical standpoint. The paper points out that a much smaller voltage may suffice if the action is progressive. The fact is that air will break electrically and ionize, or conduct, as soon as the intensity of electric stress anywhere reaches the critical value. If, for instance, near to a cloud above, or near to a sharp point below, the air breaks, it immediately becomes conducting along the line of its fracture and virtually establishes a wire from the cloud downward, or from the point upward. This rupture tends steadily to increase the local intensity of electric stress in volts per centimeter at the end of the wire, which acts like a conducting wedge, and the ions rush in behind the wedge along this conductor and help to cleave the air ahead. We can sometimes see this process on a small scale in the laboratory, with the aid of photography and a revolving mirror. The disruptive spark pushes its way further and further through the air, and, after the lapse of a brief but appreciable period, bridges the entire distance. With the aid of the electric wedge, therefore, a much lower average electric stress may enable local excesses of stress to precipitate a continuous discharge. It is doubtful whether any photographs of lightning discharges actually demonstrate this progressive action, which must be exceedingly rapid; but the bifurcating and digressive forms of flash, as shown in actual photographs, certainly suggest this action; which means, to quote Mr. Dooley in regard to the action of the U. S. government on the question of the Philippine Islands, "making up its mind as it goes along," in contradistinction to predetermining the entire course beforehand.

Joint Pole Lines.

The electric lighting and telephone industries have now available a set of rules or specifications for the construction of joint electric-light and telephone-pole lines which carry the approval of enough prominent engineers in both industries to give them great weight in all cases where questions as to the form of joint pole construction arise. We refer to the rules presented by Mr. Paul Spencer at the convention of the National Electric Light Association, which have been adopted by the two dominant telephone and electric-lighting corporations in New Jersey and have also been accepted by Bell telephone companies the country over. Moreover, these rules correspond closely with those used in electric and telephone construction in other localities where the matter has been given due engineering consideration. It sometimes happens that smaller electric lighting and telephone companies find it desirable to arrange for joint pole-line construction, but the most approved methods of such construction have not always been familiar to both parties, with the result that one or the other has held out for some very undesirable design simply because it happened to be used in the nearest town. One of the most important requirements of these rules is that the electric-light wires shall be above the telephone wires. This is one of the points concerning which there is most likely to be controversy, where the question has not been

studied thoroughly. The telephone man in the small town has been trained by experience to dread the house mover, who interferes with his cables. Consequently he wants to get as high above this interference as possible. Any disadvantage to the telephone man in this respect, however, is more than outweighed by the fact that the telephone lineman must pass up through the electric-light wires to work on the telephone lines and also that the telephone wires are much more likely to break and fall on the electric-light wires than are the electric-light wires to fall on the telephone wires. The chances for trouble, both in construction and operation, are multiplied many times by placing the telephone wires above. The electric-light wires are limited to No. 6 copper as the smallest size, as a precaution against breakage, while single conductor telephone wires are limited to No. 12 minimum size. Telephone and electric-light wires are not allowed on the same cross-arm, and the distance of 40 in. is required between the lighting and telephone conductors, which, of course, means considerably more than 40 in. separation between cross-arms when transformers are used. Space does not permit going into details further, but copies of these rules should be in the hands of all companies entering into joint pole-line construction for the first time. An article in our issue of May 16, on pages 1033 to 1035, gives an excellent idea of good joint pole-line construction as practised in Chicago substantially in accordance with the rules to which we have reference.

DISTRIBUTION OF ELECTROMAGNETIC WAVE ENERGY FROM A SIMPLE OSCILLATOR.

The complete invisibility of the electromagnetic waves employed in wireless telegraphy makes the study of their emission and distribution a slow and tedious process. With the visible waves of light, or electromagnetic waves a fraction of a micron in length, a few experiments give to the eye a fairly comprehensive grasp of the salient facts connected with the emission and distribution of these visually perceived waves. In fact, every person possessing normal eyesight has at least a crude appreciation of the main facts. But when we deal with electromagnetic waves many meters in length, which do not appeal directly to any human sense perception, we have to rely on the indications of apparatus for all our inferences. Since the conditions that affect the indications of such wave-recording apparatus are both complex and varied, the knowledge of how such waves are emitted and propagated comes slowly. Wireless telegraph waves emitted by a simple vertical sending mast are known to be distributed uniformly in all directions—north, south, east and west—unless there be some electrical dissymmetry in the neighborhood, such as dry land on one side and ocean on the other. In that case the waves are ordinarily transmitted over the ocean with less attenuation or enfeeblement than over the land. In upward directions, however, much less is known concerning the propagation of the waves, because receiving stations are nearly always on the surface of the land or ocean and are very rarely placed on balloons in the upper regions of the air. Although it is of little practical importance, therefore, what happens to the waves in upward directions, yet a complete comprehension of what happens to the waves near the ground level involves some knowledge of what happens to them above.

The current number of *The Physical Review* contains an account of some measurements by Messrs. C. R. Fountain and F. C. Blake on the distribution of electromagnetic energy from a little Righi oscillator, emitting waves about 8 in. long. The receiver, a small affair, some 3 in. long, was supported on a wooden arm that could be set in any desired direction from the oscillator. The distance between the oscillator and receiver was at most about five wave lengths, a condition representing about one mile on the scale of wireless telegraphy. A number of experimental difficulties enter into measurements made in such a manner, and it is pointed out in the article that the precision of the measurements is somewhat limited by such disturbing influences. Nevertheless, a rough exploration was enabled to be made of the distribution of wave energy in the space surrounding the oscillator. The measurements indicate that the electromagnetic forces surrounding an active oscillator are of two kinds, and not one only as is commonly supposed.

The first kind of forces are the electric and magnetic forces in the waves which are everywhere perpendicular to the radius carried from the center of the oscillator to the point considered. If we suppose each wave to expand from the center of the oscillator, like a soap-bubble, uniformly in all directions, then the electric forces will lie in the spherical shell of the bubble, along parallels of longitude drawn through the poles of the sphere, the said poles lying on the axis of the oscillator. The magnetic forces will everywhere lie at right angles to the electric forces, and along parallels of latitude of the expanding sphere. The force of the second kind is a radial electric force, or an electric force perpendicular to the expanding sphere. It is not accompanied by a magnetic component.

The electromagnetic energy due to the first kind of force increases inversely as the square of the radius. It also falls off with elevation of the radius, being a maximum at the equatorial plane, or what corresponds to the ground level in wireless telegraphy, and zero at the pole, or vertically over the sending mast. The electromagnetic energy due to the second kind of force, acting along the radius, is nil at the equator or ground level, but increases in upward directions, and reaches a maximum at the pole, or vertically over the sending mast. This component of energy, in any given direction, increases inversely as the fourth power of the radius from the oscillator. Consequently, although within a few wave lengths of the oscillator the energy due to the radial or second component may be more powerful than that due to the normal or first component, yet at a distance of many wave lengths from the sending oscillator the energy of the first component will far exceed that of the second, since the latter dwindles with distance so much faster. If we may apply these deductions to wireless-telegraph conditions, it would seem that at the ground or ocean level there is no radial component, and the receiving mast should be in the vertical plane for maximum effect. Up in a balloon however, and within view of the sending mast, the receiving wires should lie vertical, or in the drag rope and not inclined perpendicularly to the radius from the mast. Immediately over the mast, a horizontal receiver wire might detect no waves, whereas the vertical receiver wire in the drag rope would respond to the radial or second component.

The International Telegraph Conference in Lisbon.

The International Telegraph Quinquennial Conference, which began its sessions at Lisbon on May 4, was in session throughout the month and is expected soon to end its labors. Hon. C. P. Bryan, the United States Minister to Portugal, gave a reception to the delegates on May 17. An official banquet was given to the delegates May 4, and two days later they attended the coronation of King Manuel.

At the opening of the conference, the delegates were welcomed by an address from the Minister of Public Works, Senhor Carnet de Magalhaes, after which the conference was presided over by the principal Portugese delegate, Councillor Alfredo Pereira, Director-General of Posts and Telegraphs, and vice-president of the Portuguese Chamber of Deputies. The vice-presidents selected were: Councillor P. B. Cabral, of Portugal; M. Peter de Szalay, of Hungary, and Colonel E. Frey, director of the International Bureau, Berne, Switzerland. After the inaugural proceedings the delegates elected four committees to deal with (1) rules and regulations, chairman, M. H. Babington Smith, of England; (2) rates, chairman, M. Bordelongue, of France; (3) telephones, chairman, M. Pop, of Holland; (4) drafting, chairman, M. Banneux, of Belgium. A special committee has also been appointed to consider a number of propositions relating to the revision of the St. Petersburg convention of 1875, under which all matters relating to international telegraphy are regulated. Among those in Lisbon during the conference have been Mr. R. R. Dennis, representing the United States Department of Commerce and Labor, and Vice-President George G. Ward, of the Commercial Cable Company.

No official details of the complete conference have yet been given out, but various details are public. The Mercadier telegraph system was brought to the notice of the conference. China has filed, it is understood, a statement or protest as to the infringement of her telegraph rates in Manchuria. As to one important practical point, Sir J. Wolfe Bary said, on May 13, when presiding at the half-yearly meeting of the Eastern Extension, Australasia & China Telegraph Company: "Judging from what appeared in the newspapers a few weeks ago, considerable misapprehension appeared to have existed on the part of the Chambers of Commerce and telegraphing public generally as to the action of the government and cable companies at the conference in regard to the use of artificial words in code telegrams; but the publication of the Postmaster-General's letter to the Chambers of Commerce on the subject would have made it clear that it was not proposed to withdraw the privilege, but only to endeavor to have more clearly defined the condition as to the 'pronounceability' of artificial words. When the concession of admitting 'pronounceable' artificial words on the footing of code at 10 letters to the word was granted, it was assumed that the privilege of making up codes on this basis would be used in a reasonable manner, so that the telegraph service, whether by cable or land line, might not unduly suffer, while the public would be benefited. This expectation has not been completely fulfilled. Before the new regulations came into force the British Post Office found it necessary to issue a circular to the Chambers of Commerce, as well as to the principal code makers, directing attention to the fact that codes were being compiled of artificial groups which, in many cases, could not be regarded as 'pronounceable,' and that such words would be difficult to transmit, and would lead to errors. In many cases code makers had recognized the importance of avoiding combinations which were of doubtful pronounceability, but in some cases an unreasonable use of the concession had been shown. As an instance of this, such words as 'bujksrocty,' 'bywrgrocbx' and 'liqraqkqcr' might be mentioned as words which appeared in a code recently submitted. It would be readily understood that a telegraphist could deal more rapidly and easily with a pronounceable word, which could be more quickly grasped and remembered while it was being transmitted, as compared with an arbitrary combination of letters requiring a separate effort of attention for each letter. Thus greater speed and accuracy, which were what the public required, were obtained, and there was less need for repetition and corrections. It was desirable and to be hoped that the condition as to pronounceability would at the conference be more clearly defined, in order to put some limit for the future to the growing tendency, which, if unchecked, could not fail to produce results highly injurious to the telegraph service and consequently to the public and commerce. There was, however, no intention of adopting other than a wide and even generous interpretation which would cover the great bulk of the codes at present in use."

Temporary Shut-Down of Niagara Falls Power.

Responding to a request of the International Railway Company, the Niagara Falls Power Company will on Sunday, June 14, between the hours of 1 a. m. and 3 p. m., shut down its two big stations in Niagara Falls, thus shutting off the water from the tunnel tailrace. This will be done to afford the International Railway Company an opportunity to make a thorough inspection of the condition of the American abutment of the upper steel-arch bridge. This abutment stands close by the tunnel portal, and the outrush of water speeds by and against it with tremendous fury. It has been known for some months that the water appears to be weakening the foundation, and attempts have been made to strengthen it without success. When the water is off next Sunday, divers will go down and examine the river side and the tunnel stream side in a very thorough manner in order to obtain reliable data for guidance should repairs ever be deemed advisable.

While the power houses are closed down the factories at Niagara receiving current from them will cease operations, but the trolley lines of the Niagara-Buffalo locality will be operated by current supplied from the station of the Canadian Niagara Power Company. During the shutdown, the engineers of the Niagara Falls Power Company will make a very complete inspection of the wheelpits and of the tunnel in order to determine how they are wearing. No such inspection has been made since June 1, 1902. The tunnel has now been in use about 13 years, the first unit that discharges water into it having been started in 1895. It will be remembered that the wheelpits and tunnel are brick-lined throughout.

Trouble Over Chicago Drainage Canal Power.

A remarkable clash of arms has taken place in Chicago between two public bodies, the trustees of the sanitary district which controls the Chicago Drainage Canal and the City Council. The sanitary district trustees control the water-power plant at Lockport, which obtains power from the drainage canal. About 5000 kw is now being transmitted and sold to the city of Chicago for street lighting purposes. This is transmitted from Lockport to a substation near the city limits at a voltage of 44,000. At the substation it is stepped down to 13,000 volts and transmitted to various municipal lighting plants, as previously described in these columns. The sanitary district trustees, however, have not confined themselves to supplying power to the city of Chicago and to the park boards and other public enterprises, but have entered the commercial power field and are soliciting power business of manufacturers. The stringing of the wires of the sanitary district has been opposed in numerous cases on the grounds that frontage consents have not been obtained. Under a law passed in Illinois in 1897, a franchise cannot be granted to a person or corporation to put a pole line on a street until the consent of a majority of the property owners has been obtained for each mile of street. The contention of the sanitary district trustees is that because the sanitary district is not a corporation or person, but a public

body, it is not bound by this law. There also appears to be a difference of opinion between the sanitary district trustees and the city officials as to the occupancy of city conduits and poles by wires of the sanitary district. An investigation has been started by the Citizens' Association to find out the reasons for the apparent clash between these two public bodies, both of which are supported by public taxation.

Decision of New York Public Service Commission on Consolidation.

The New York State Public Service Commission of the Second District has announced that its settled policy is not to grant permission for a foreign corporation to acquire control of any domestic corporation for the furnishing of gas or electric service in New York State, for the reason that as soon as it became a part of a foreign corporation the power of the commission to control its capitalization was lost, and this was one of the important powers which the public service commissions law took care of.

This announcement came out in connection with an application of the Twin State Gas & Electric Company and the Hoosick Falls Illuminating Company for authority for the latter company to transfer its franchises and works to the former company by merger and for the Twin State Gas & Electric Company to acquire the capital stock of the Hoosick Falls company. The Twin State company is a Connecticut corporation, which has a plant in Bennington, Vt., and it desires to acquire the Hoosick Falls plant, 12 miles distant.

Rates and Contracts of New York Electric Companies.

Public Service Commissioner Maltbie on May 20 informally discussed with the representatives of the various New York electric companies the advisability of substituting a brief form of application for the contracts which have heretofore been used by the companies, and took up in detail the provision of such an application, which had been tentatively prepared and submitted by the companies. At the following hearing, on May 27, Mr. Lieb, of the Edison company, submitted schedules bearing on arc lighting and power for public buildings, and arc and incandescent street lighting. The arrangement for arc lighting between the city and the New York electric companies are as follows:

New York Edison Company, contract for one year to Dec. 31, 1908. Annual rate of charge per lamp: 450-watt lamp, $100; two lamps of 250 watts each, $130 per post (two lamps); 325-watt lamps, $90. United Company, contract for one year to Dec. 31, 1908; 450 watts, $100. Westchester Company, no contract; 475 watts, $100. Bronx Company, contract for one year to Dec. 31, 1908; 400 watts, $105. Brooklyn Edison, contract for one year to Dec. 31, 1908; 325-watt lamp, $90; 450-watt lamp, $100; for less than 5000 lamps. Flatbush Company, contract for 15 years from May 1, 1894, and one year to Dec. 31, 1908; 350, 450, 375 watts, $97.50. New York & Queens Company, contract for one year to Dec. 31, 1908; 400 watts, $90. Queens Borough Company, contract for one year to Dec. 31, 1908; 400 watts, $90. Richmond Company, no contract; 400 watts, $100.

Mr. Arthur Williams testified that there were between 50 and 60 Edison consumers whose contracts did not correspond technically to the standard forms. Of these there are 25 who pay at the rate of 10 cents per kw-hour for the first 7 hours of daily use, and 5 cents per kw-hour for all excess over 7 hours average daily use. These contracts were made on or immediately after July 1, 1905, when the new law took effect, making the maximum price for electric current 10 cents per kw-hour. The company, Mr. Williams said, did not want to take advantage of the new law to raise the rate prevailing with those customers. The contracts mentioned are terminable at 30 days' notice on either side. Mr. Williams said these consumers were getting current at a rate slightly less than the average consumer who pays 10 cents per kw-hour and that the company at one time contemplated the termination of this class of contract, but allowed it to stand in view of an opinion rendered by the counsel for the commission that the company is compelled to continue the service under the former rate. Commissioner Maltbie held the view that to continue a special contract when others in the class are paying a higher or a lower rate, was to set aside the common low rule against discrimination. Mr. Williams said that at present no special contracts of any kind are made by the company and added that the number of special contracts in existence 10 years ago was not, in his belief, larger than at the present time.

At the hearing on June 4, Mr. Williams again took the stand and said that in addition to the 52 special contracts mentioned at the previous hearing there were four special tunnel contracts at rates of 4 cents per kw-hour for current used in tunnel construction. The company, according to Mr. Williams, is willing to make such contracts with any person engaged in similar work. Breakdown service department house lighting and special forms of contracts were discussed during the remainder of the hearing. Adjournment was taken to June 5. On that date no testimony was taken and the hearing was adjourned to June 8.

Jersey City and Electric Light and Power Franchises.

A franchise was granted the Mutual Benefit Electric Light & Power Company of New Jersey to operate an electric light, heat and power business in Jersey City, N. J., by the Board of Aldermen, by a vote of 22 to 1, at their regular monthly meeting in May. The franchise went into effect immediately after the passing of the ordinance granting it. The Mutual company in its application for a franchise stated through its counsel, various benefits the city would receive if it were granted a franchise. Among its promises were that it would put all wires underground; would not sell out or merge with any other like corporation; would supply lighting service at 8 cents per kw-hour, with a 5 per cent discount for payment of bills within five days after presentation, which rate it claimed would mean a saving of nearly $170,000 per year to the present consumers. In addition to this the company agrees to give 5 per cent of its gross receipts to the city for the privilege of laying its wires underground, which is expected to reach from $10,000 to $40,000 per year. It further agrees to light the streets of the city at the rate of $65 per arc lamp per year. The officers of the company are: Mr. James E. Seymour, of Newark, N. J., president; Mr. John F. Nagle, Jersey City, treasurer; Mr. Richard S. Carrick, Jersey City, secretary.

The ordinance granting the franchise, which is for a period of 20 years, requires that all pipes or conduits shall be at least 2 ft. below the surface; that they shall not in any way unnecessarily obstruct or interfere with public or private property, and shall not be laid nearer than 3 ft. to any water or gas main, except in cases where it shall be necessary to cross or intersect the same. It shall furnish electricity for electric lights, heat and power to any and all of its customers at the maximum rate of 8 cents per kw-hour, and give 5 per cent discount on all bills paid within five days of presentation, and further, pay annually to the treasurer of the city of Jersey City 5 per cent of the gross receipts from current sold to its customers in the city of Jersey City. The company is required to construct and lay each year during the term of the franchise at least two miles of pipes and conduits and equip the same for the supply and distribution of electric light, heat and power; but is not required to lay pipes or conduits while the validity of the ordinance is under contest in the courts of the State. In case of failure to perform any of the provisions of the ordinance, the city will have the right to revoke the ordinance and thereupon all pipes and conduits laid in the streets shall become the property of the city. Upon the expiration of the term of 20 years all pipes and conduits laid in the streets hereunder shall become the prop-

erty of the city, upon the payment of the value thereof, excluding franchise rights to be fixed by arbitration in case the city desires to purchase the same. Before disturbing the surface of any street for the laying of its pipes and conduits, the company is required to deposit with the city clerk the sum of 75 cents for each lineal foot of conduit to be laid therein, as security for the restoration of the street to its former condition, which sum, less the inspector's fees, shall be returned to said company in three months after the completion of said work, and the satisfactory restoration of the streets; the city shall have the right to use said deposit for the restoration of said street if the company shall fail to do the same satisfactorily.

As we go to press, announcement is made that Mayor Wittpenn has vetoed the ordinance granting a franchise to the Mutual Benefit Company on the ground that he did not feel that such franchises should be granted unless reasonable assurance is obtained that good results would follow.

Boston Edison Rate Decision by Massachusetts Commission.

The Massachusetts Gas & Electric Light Commission recommends that on and after July 1, 1908, the Boston Edison Company shall offer to sell electricity for any use at a uniform price not to exceed 12 cents per kw-hour, and that, if a customer elects to be served under the present schedules, his average price per year shall not exceed 12 cents per unit. Further reduction by Oct. 1, 1909, may be approved by the board unless the company can show good reasons to the contrary.

This decision is the outcome of a long investigation of the system of charging in use by the Boston Edison Company, extending back over a year and including 10 public hearings. The petitions asking for a reduction and change in the methods of charging was the Public Franchise League, of Boston, represented by its secretary, J. B. Eastman. The company was represented by its attorney, E. W. Burdett.

In its decision the board discusses the territory served, the distinctive characteristics of the central station as compared with the gas business, the investment in plant, the peak loads, theory of rates and resulting prices in force in the Boston district. The company uses a modification of the Wright demand system, which charges each customer substantially the cost of supplying him, including a reasonable return on the investment made in his behalf. It divides its expenses into "fixed" and "running costs," and to find the fixed cost per customer it introduces a "diversity factor," calculating that the average yearly fixed cost per kilowatt of maximum demand for its lighting customers is two-thirds and for its power customers is one-quarter the actual average yearly fixed cost per kilowatt of maximum station demand. The primary hours and rates are designed to take care of this feature of making the customer pay his proportionate share. The use of wholesale discounts relieves the larger customers of the excess costs occasioned by the smaller ones. The present rates were put in force on July 1, 1906, but the demand system of determining rates were adopted in 1898.

In the year ending June 30, 1906, the company sold 51,157,932 kw-hours, and the maximum station load was 26,311 kw. Dividing the annual expenses, including dividends, as between "fixed" and "running" costs on the basis used by the company, the fixed costs averaged $118 per kilowatt of maximum station demand and the running costs 1.25 cents per kw-hour sold. Correcting these results by the so-called "diversity factors," $80 is the average amount of fixed costs required of lighting customers and $30 of power customers per kilowatt.

Abstracts of the report here given show that the chief question was to what extent, if at all, a differential system of rates, such as the company has adopted, is unlawful because discriminating. The company contended that differential rates founded on differences in cost and condition of supply are lawful. With the change to saying that such rates are not necessarily unlawful, this contention may be conceded. It perhaps may also be conceded that competition, applying to one class or a portion of the company's business, may produce such difference in conditions of supply as to make not unlawful a difference in rate. So, too, rates established for certain classes of customers, or as they apply to certain classes, may not be unlawful even though returning less than their full proportion of profit.

The question of superior importance is whether or not the company's system of rates is on the whole consistent with those principles of sound public policy which should govern the relations of the company to the public which it serves. The purchase of suburban plants has necessarily involved a considerable abandonment of property and waste of invested capital, and the making good of this waste has borne heavily upon the earnings of the company reserved for depreciation. A larger experience than is yet available will furnish a satisfactory demonstration of its justification. This extension of the company's business may in time prove to have been in the public interest.

The expenses for generating and distributing the current made and sold are low and compare favorably with similar expenses of other large companies not only in this State, but in New York, Brooklyn and England. These facts indicate that the Boston company in this respect is skilfully and efficiently managed. On the other hand, the general expenses of the company considerably exceed all the other companies with which comparisons were made. Taxes in 1907 were over $453,000, or over 40 per cent of general expenses. This the company cannot control. The cost of obtaining new business in 1907 was $125,497.60, exclusive of the expense of quarters occupied by that department, or of the current used for demonstration, signs, etc. The figures for the year show as a result an increase in output of 20 per cent, or an increase in receipts of $261,742.74 (7 per cent), which would have been increased $200,000 more but for the reduction in rates of June 30, 1906. Judged by the immediate results obtained, this amount, and especially the expenditures for advertising in some of the Boston papers, seem excessive. The board has no criticism, but rather encouragement for the proper remuneration of an able and efficient management and for reasonable expenditures in efforts to extend and increase business.

The company seems to assume as the essential premise in its demonstration that the ratio of a customer's maximum demand to the aggregate demands of all customers, other conditions being equal, represents with reasonable accuracy his proportional share of the company's investment, and, therefore, of the fixed costs. The diversity factors adopted by the company are not based on its experience nor was it shown that they are based on the experience of others under substantially similar conditions. While the evidence tended to show some recent effects to test the accuracy of these "factors," it also tended to show that residence lighting, for example, might have a far more favorable diversity factor than the one assumed in making the present lighting rates, and this is probably because, that, unlike business lighting, the maximum demands of residence customers are not so nearly coincident. Before the diversity factors are used, the fixed costs should be divided as between lighting and power customers, which is obviously impracticable. The difficulty of finding the particular cost of an individual customer is also illustrated in the company's division of its annual expenses as between "fixed" and "running" costs.

The board is of the opinion that no differential system of rates for a public utility can be equitably and properly based solely upon the cost to the company of supplying the individual. The company has a public duty to perform and is bound to discharge it for the equal benefit of all. At best the company can assign the costs of supplying its customers only on broad lines and upon certain general assumptions and averages. There can be no more desirable requisite for a public service than that it shall be simple, definite and readily understood and applied.

On the basis of electricity sold and the maximum station demand during the year ending June 30, 1907, the company required but an average of $95 per kilowatt of maximum station demand to meet its so-called fixed costs and against $118

the preceding year. This would seem to warrant a reduction in the primary rate of 20 per cent to 12 cents. The present light rates enable the company to select desirable customers only, and tend to discourage small users from becoming customers.

In an analysis of the last year, non-contract lighting customers represented 15,000 out of 20,000, or 75 per cent. They used an average of 512 kw-hours of their aggregate maximum demands out of the 520 hours required by the company's schedule. Two years ago the company made a voluntary reduction from 18 cents to 15 cents. No recommendation was made in regard to street lighting. The present proposed reduction will probably cost the company at least $200,000.

President Edgar of the Edison Electric Illuminating Company, of Boston, has written a letter to the Massachusetts Gas and Electric Light Commission accepting the recommendation of the board in regard to rate reduction, but not admitting the incorrectness of the theory of differential prices or that the company has not proved them to be based on cost. Beginning July 1 the schedules A and A1 (15 cent primary and 12 cent secondary rate, and the church rate) will be discontinued, and a new commercial lighting rate schedule of 12 cents per kw-hour will be charged, with a minimum meter charge of $1 per month. The company feels that the board has not given sufficient importance to the state of the times and the effect of the new high-efficiency lamps upon its business.

Increase of Power Companies' Valuations.

The New York State Tax Commissioners have notified a number of corporations in Utica that there has been a large increase in the valuation for 1908 of the property of certain companies holding special franchises. Among the companies which have had their valuations increased are the following: The Utica Gas & Electric Company, whose assessment of last year of $575,000 has been raised to $700,000; the Utica Home Telephone Company, from $115,650 to $125,650; the Utica & Mohawk Valley Railroad Company, from $650,000 last year to $1,020,000. The Central New York Telephone Company, whose assessment last year was $155,000, has also had its assessment increased. The companies have the right to appeal from the valuations, and it is expected that a number of them will take advantage of this right, which will take the form of a protest to the city. Following official notice on the part of the city, a public hearing will be held, at which representatives of the companies and of the city will appear.

Hearing on the New York Central's High-Tension System.

The Public Service Commission resumed on June 4 the hearing on the question as to whether the New York Central should be permitted to maintain its high-tension overhead system. Mr. Henry Floy, consulting engineer, retained by the city, who was on the witness stand when the hearing adjourned May 22, continued his testimony. Mr. Floy gave it as his opinion that the method employed by the railroad for insuring safety for aerial wires at other crossings on its lines, namely, by furnishing an iron bridge under the wires to keep them off the road in case of an accident, was impractical at the Kingsbridge crossing of the Interborough tracks on account of the height of towers that would be required. He, therefore, expressed the opinion that the underground conduit was the safest plan that could be adopted at this crossing. He was also of the opinion that there would be little difficulty in the construction of such conduits. Mr. Floy did not believe that the expense of constructing conduits underground at this point would be excessive. He considered the New York Central's estimates of the cost of underground installation too high, and he also declared that there was plenty of room on the right-of-way for conduits. Mr. Floy's total estimate of the cost of putting the high-tension wires underground on the 10.4 miles of track in the city was $1,453,660. These figures were reached by careful inspection of the right-of-way, using the railroad's maps as a basis of measurement. Mr. Floy's figures were for 16-duct conduits. He also submitted a second estimate covering the replacement of the aerial lines on the Harlem Division as far as Woodlawn and on the Hudson Division as far as Spuyten Duyvil, which he suggested as a substitute for the larger proposition and as securing all the advantages of the latter for the construction would avoid crossing aerially all streets and highways or the necessity for placing any poles near the tracks within the city limits.

This estimate amounted to $988,324, and was based on the same premises as the first estimate, except the number of ducts was reduced from 20 to 16, as at present only 8 to 10 ducts would be required for putting the present aerial conductors under ground. Mr. Floy stated that he considered these figures, based on the unit price assumed by the New York Central's engineers, as very safe and he believed the work could be done considerably under this figure. He stated that on one inspection he had taken with him a representative of one of the largest contracting companies in the country, who made an estimate, including the wires and cables, which amounted to considerably less than $600,000.

At the hearing on June 5, Mr. Floy was cross-examined by Mr. Lyman, attorney for the railroad, without materially changing his evidence given in direct-examination. He was especially called upon to compare the aerial system of the St. Croix Power Company, of which he was chief engineer, with the system installed by the New York Central, with a view to showing the latter was as safe or safer than the former. Mr. Floy was examined as to the aerial lines of the Long Island Railroad and the New York, New Haven & Hartford, Mr. Lyman's point being that the Central should not be ordered underground if these roads were permitted to use aerial lines.

In reply to a question, Mr. Floy said it was not feasible to require all electric light and traction companies to place their wires underground, as to do so would put many out of business.

Niagara Power.

The Canadian members of the joint International Water Ways Commission have submitted a report on the work of the Commission to the Canadian Parliament. It recommends that the government of the United States shall prohibit the diversion through the Chicago drainage canal of more than 10,000 cubic feet of water per second, which amount is said to be sufficient for the sanitary purposes of Chicago. It is estimated that this diversion will lower Lake Erie 5 in. The Commission recommends that no dam or dams be allowed in the Niagara River with a view to maintaining the level of Lake Erie. In regard to the use of power from Niagara Falls, the conclusions are: first, that it would be a sacrilege to destroy the scenic effect of the falls; second, that not more than 36,000 cubic feet of water per second on the Canadian side and 18,500 cubic feet per second on the United States side, should be diverted.

The Canadian members, while consenting to these conclusions, did so upon the understanding that any treaty on that basis should be limited to the term of 20 years, and should establish a principle applicable to all diversions or uses of waters adjacent to the international boundary, and of all streams which flow across the boundary. The Canadian Commission considered that it would have been wise if development had been limited to the generation of electricity for distribution in Canada. The three Canadian companies are now permitted to develop a total of 400,000 hp, and are compelled to take care of the Canadian market to the extent of at least one-half the power generated. The Commissioners say that one-half the production would undoubtedly supply all the demands from the Canadian market for many years to come, and it would not be any great hardship to compel the companies jointly or severally to build the necessary transmission lines for distribution of the power.

Electricity at the Franco-British Exhibition.

To mark the establishment of friendly relations between England and France, and to assist in strengthening the entente cordiale, the Franco-British Exhibition is now being held at Shepherd's Bush, London. The area of the exhibition site is 140 acres, or 200 acres inclusive of all the approaches. Within this space are 28 large palaces and halls, surrounded by a number of smaller buildings. Special attention has been given to the electrical equipment and illumination. Over 2000 arc lamps are installed for public lighting, and it is said that over 100,000 incandescents can be seen at one given point, illuminated at the same time. The exhibition was opened last month by the Prince of Wales, and has just been visited by the King and President Fallières of France. During the summer a great many American visitors are expected, and although the exhibits are restricted to English and French products, this will include many American articles made in one country or the other.

FIG. 1.—FRANCO-BRITISH EXHIBITION BY NIGHT.

Electrical energy for the exhibition is supplied by the Hammersmith Borough Council, within whose area the exhibition lies. This service is supplemented by that of the Notting Hill & Kensington Electric Supply Company, as sub-contractors. The Council charges the exhibition 2 cents per unit from sun-

FIG. 2.—FRANCO-BRITISH EXHIBITION BY NIGHT.

rise to sunset and 4 cents from sunset to sunrise, with a minimum guarantee of $50,000. The sub-contract calls for current from the company delivered to the Council for 0.4 cent per unit with a guaranteed minimum of 1,000,000 watts and 0.375 cent for all units above that quantity. The Council current is single-phase, 50 cycles, at 2200 volts; the company current is three-phase, 5000 volts, and 45 to 50 cycles. Short feeders are run from the plants, consisting of concentric cables in earthenware ducts. There are two substations, each divided for single-phase and three-phase supply, respectively, and provision is

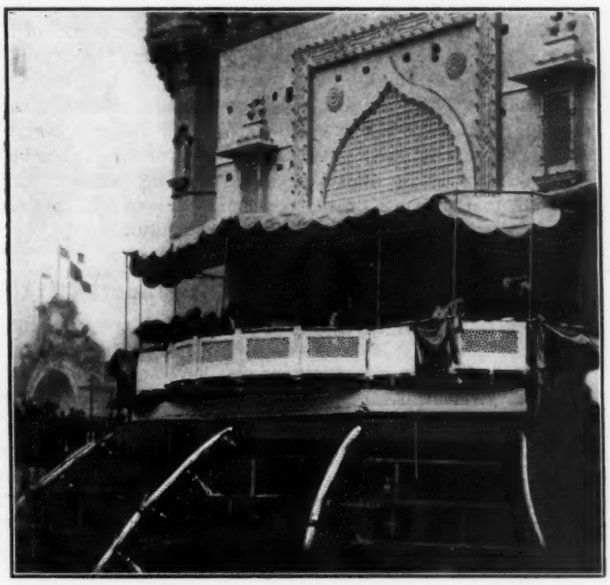


FIG. 3.—OPENING THE INDIAN COURT.

made by motor-generator for direct-current supply. In the Machinery Hall have been installed generating plants, gas and steam, whose electrical energy is also availed of for use in the exhibits. There are also individual exhibits in separate buildings with their own generating plants.

A very interesting feature of the exhibition is the display of

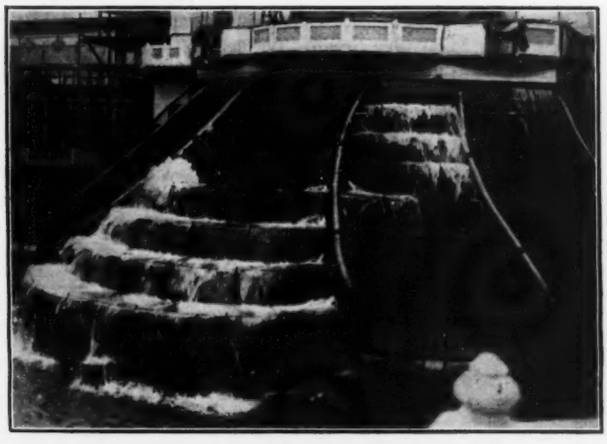


FIG. 4.—TURNING ON WATER TO FOUNTAIN.

apparatus for purely scientific methods of research. A space of 14,000 sq. ft. has been set aside for this and placed at the disposal of a number of scientific men, including Sir Norman Lockyer, Prof. John Perry and Sir Alexander Pedler. This novel department is divided into sections, each representative of a leading branch of research, such as magnetism and electricity, light and photography, chemistry, meteorology, etc.

Our views show the lighting effects of the Court of Honor, etc., for which the "Fairyland" system has been adopted, using a special twin rubber-covered cable on the lampholders every 12 in. These lampholders are of a special watertight pattern connected without cutting the conductors, so that a bad contact affects only the particular lampholder. Some 100,000 of these lights have been placed on exteriors, in such a way that 200 lamps of 5 cp constitute a circuit on a pull-and-push switch with fuse. The lighting of the great Stadium where the Olympian games will occur is also one of the notable features, and has been done with 146 flaming arcs. The Grand Restaurant also is lighted with 5000 lamps arranged decoratively. Covered passages leading from the Uxbridge Road station to the exhibition have been lighted with no fewer than 400 flame arcs.

A good deal of extra electrical work and service are required of the transportation authorities. The Central London Railway has extended its line from the Shepherd's Bush terminus to a station at Wood Lane adjacent to the main entrance to the exhibition, and the Hammersmith & City Railway has erected a special station at the grounds. The London County Council has built an overhead trolley line in Wood Lane for the Horlesden and Harrow Road districts, and the London United Tramways has access at Uxbridge Road through the covered approach referred to above. These facilities will handle 70,000 passengers an hour, besides which there are lines of motors, omnibuses, etc.

Electrical Train Lighting Equipment on the Austrian-Hungarian Government Railroad.

A successful trial of the Rosenburg train-lighting generator equipment was made recently on the Austrian-Hungarian Government Railroad. The car used for the test contains six compartments each of which is equipped with two 16-cp tungsten lamps. The car also carries five other lamps of the same type and rating. The lamps operate at 32 volts, while the generator is designed for an e.m.f. of from 44 to 58 volts, the full load output being 30 amp. A storage battery capable of supplying energy to the lamps for six consecutive hours has been installed. Iron ballast resistors of the cartridge type are connected in series with the lamps when they receive energy from the generator. These resistors are mounted in the vestibules. In the vestibules are also mounted field rheostats which serve for adjusting the voltage of the generators when charging the storage battery, and an automatic reverse-current relay which prevents the battery from feeding energy to the generator when the speed is low. It is reported that the lamps give steady light and do not show flickering when the train is accelerating or retarding.

Electrifying German Railroads.

United States Consul Talbot J. Albert, stationed at Brunswick, Germany, reports that a beginning in electrifying some of the railroads in Prussia will soon be undertaken, the preliminary plans being as follows:

The railroad ministry will permit the first great attempts to be made with electrical power in connection with the centrals now existing in the administrative district of Magdeburg. First, the short sections Güsten-Stassfurt and Güsten-Bernburg-Köthen will be arranged for electrical operation. Later there will be a change of power on the line Magdeburg-Bitterfeld-Leipzig, and afterward on the line Halle-Leipzig. Upon these, in themselves complete lines of road, electrical power will wholly supplant steam.

The line Leipzig-Halle has been chosen for a special reason. By the electrical operation between these two points there will be a greater increase in the speed and frequency of the trains dispatched, so that in this way Leipzig will be brought into closer connection with the western main lines. The managements of two lines have been instructed by the ministry at Berlin to make a detailed inquiry how far electrical power can be economically used in comparison with the present method of operation. It is said that the preliminary work for this statisti-

cal inquiry has already been done by the ministry, so that the administration at Halle has only to verify the results already obtained.

The most favorable factor for the economical determination of the question are the bituminous deposits (Braunkohlen) between Halle and Leipzig. This kind of coal is not considered a suitable fuel for locomotives. One electrical central will suffice for the operation of both lines, and this will be built in the midst of the coal fields.

It is said the passenger traffic will be handled in the same manner as upon the road Berlin-Lichterfelde-Ost, namely, with small trains and quick service. The express and freight trains will be dispatched with electrical locomotives. The length of the two lines together amounts to 102½ miles, the line Leipzig-Magdeburg being about 80 miles and the line Leipzig-Halle 22½ miles. It is calculated that the change in the system will take two years. Current will be distributed at 10,000 volts.

Bellows Type Relays for High-Tension Switches.

Mr. R. F. Schuchardt, at a meeting of the Chicago branch of the A. I. E. E., held June 5, 1908, read a paper on "Recent Developments in Protective Features of a Large High-Tension Underground System." This took up mainly the work done by the Commonwealth Edison Company's staff in Chicago in developing the bellows type of relay for high-tension switches, some very important advances having been made. He described briefly the extensive system of stations, substations and transmission lines of the Commonwealth Edison Company. Oil switches using the simple solenoid and plunger type of overload relay and combined with a fixed time-limiting device were first used, the time limit of opening being six seconds. This proved too long and was later reduced to two seconds, but as there was considerable trouble, the time limit was abandoned temporarily, leaving only a plain relay with instantaneous action. As the system grew the necessity became more urgent for selective action of relays, so that only certain switches would open under certain conditions. Attempts to get selective action by setting relays at substations lighter than those at generating stations were not successful for heavy short-circuits, as all relays would open.

Mr. Schuchardt then described in detail the steps in the evolution of the bellows type relay in which the shortness of the time in which the relay will operate depends on the amount of current flowing. Quick recovery valves to allow the plunger to resume its normal position rapidly after opening a circuit were introduced, but turned out to be a source of trouble, as they permitted chattering, vibration and pumping to an extent which actually caused the relay to open slower on short-circuits than on overload. He exhibited curves plotted from tests of overload relays showing the time in seconds required to open with various values of current. He showed that although several relays might give the same results with a certain current, they would not necessarily give the same results with a higher or lower current value. He also showed that earlier types of bellows relay did not act with sufficient rapidity on short-circuits, although the action was sufficiently rapid on lighter currents. This difficulty has been overcome by one of the engineers of the company's testing department, who substituted for the manufacturers' air valve a simple device which is a combination of a needle valve and a pop valve. The needle valve governs the rapidity of action under overloads, while the pop valve permits quick action with heavy short circuits. Tests on oil switches show that they require from 0.2 to 0.6 second to operate after the tripping switch operated by the relay is opened. In generating stations the company uses overload relays on transmission lines only. No automatic devices are on the generator switches. In every case the switchboard operator has promptly disconnected the correct generating unit in case of trouble. Mr. Schuchardt's paper went into practical details in a very satisfactory manner and was followed by contributions from central-station electrical engineers of Milwaukee, St. Louis, New York and Boston.

Canadian Electrical Association Convention.

The convention of the Canadian Electrical Association is to be held in the Chemistry and Mining Building of the University of Toronto on June 17, 18 and 19. About 400 delegates are expected to attend.

Space has been provided in which to make exhibit of standard, special or new devices, which manufacturers and dealers may desire to bring to the notice of the electrical people in attendance. This space consists of two large rooms about 32 ft. x 50 ft., and the corridors of the basement and ground floors of the building. There are available both 220- and 110-volt direct-current circuits, as also a small capacity in 110-volt, 60-cycle alternating-current service. An efficient janitor service has been arranged to assist in unpacking and arranging exhibits. Contributors to the funds of the convention are offered one unit of exhibit space for each $25 of their contribution.

Association of Electrical Engineers of the Iron and Steel Industry.

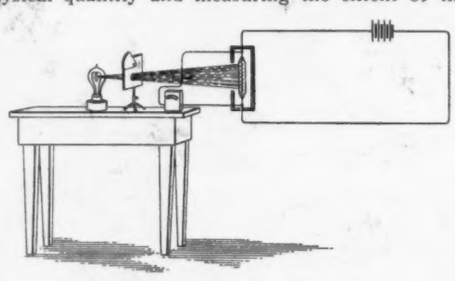
Following is a list of committees that have been appointed by the officers of the Association of Electrical Engineers of the Iron and Steel Industry:

Finance, Messrs. E. W. Yearsly, chairman; G. H. Winslow, James Farrington; papers, Messrs. E. W. Yearsly, chairman; P. D. Brown, G. W. Richardson, G. M. Sturgess; library, Messrs. G. H. Winslow, chairman; L. R. Palmer; board of examination, Messrs. B. R. Shover, chairman; J. C. Reed, L. R. Palmer; editing, Messrs. L. R. Palmer, chairman; G. H. Winslow; standardization, Messrs. F. P. Townsend, chairman; G. W. Richardson, G. M. Sturgess. Mr. G. H. Winslow, Frick Annex, Pittsburg, is secretary and treasurer.

The next meeting of the association will be held in Philadelphia June 24 and 25.

Selenium Photometer.

Mr. William J. Hammer obtained two patents on May 26 relating to the use of selenium in photometry, the claims of which seem to be very broad. The leading claim of one patent is as follows: "The new art of measuring light which consists in causing the light to be measured to vary an ascertainable physical quantity and measuring the extent of the varia-



SELENIUM PHOTOMETER.

tions." The claims of the other patent cover apparatus for applying the light-measuring method suggested.

The accompanying illustration shows diagrammatically one of the proposed arrangements of apparatus. A voltmeter indicates the change produced in the resistance of a selenium cell when the light to be measured falls upon it. The selenium is inclosed in a vacuum to exclude moisture and thereby to eliminate the polarizing e.m.f. that may be produced by electrolytic action when moisture is present. Moreover, by the use of the vacuum the deleterious effects of gases produced by heating are avoided. The tube is preferably made of quartz in order to admit certain rays that are excluded by glass.

Annual Convention of the A. I. E. E.

During the annual convention of the American Institute of Electrical Engineers, to be held at Atlantic City from Monday, June 29, to Thursday, July 2, both the headquarters of the Institute and the place of conducting the meetings will be at Hotel Traymore.

The exercises will begin with an address of welcome to be delivered on Monday morning at 11 o'clock. Following this will be the address of President H. G. Stott. The morning session will close with the presentation and discussion of a paper by Mr. C. M. Goddard on "Electricity as Viewed by the Insurance Engineer," in which the author pleads for closer co-operation between the A. I. E. E. and the National Fire Protection Association, whose interests lie in the same direction.

The program of papers will be presented at sessions on Monday afternoon, Tuesday morning, Tuesday evening, Wednesday morning, Wednesday afternoon, Thursday morning and Thursday afternoon. Unless the time consumed in presenting and discussing the papers exceeds the amount allotted to them, no session will be held on Friday, so that members will be free to make such plans as they may desire for the Fourth of July, which falls on Saturday.

The portraits on the following page are of the officers elected at the annual meeting in May, who will assume office August 1. The present officers of the Institute are as follows:

President, Mr. H. G. Stott; secretary, Mr. Ralph W. Pope; treasurer, Mr. Geo. A. Hamilton; vice-presidents, Messrs. H. H. Humphreys, A. H. Armstrong, Frank G. Baum, James G. White, W. C. L. Eglin and L. A. Ferguson; managers, Messrs. C. C. Chesney, Bancroft Gherardi, Chas. L. Edgar, Calvert Townley, John J. Carby, A. M. Schoen, Paul M. Lincoln and Paul Spencer.

H. G. STOTT,
President.

An indication of the character of the papers that will be presented at the convention is given below:

ELECTRICAL MACHINERY.

"Modern Developments in Single-Phase Generators," by Mr. W. L. Waters, engineer, Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Describes the methods employed for overcoming the disadvantages of the pulsation of the armature reaction and the mechanical stresses on the end-connections of the armature coils of single-phase generators.

"A New Large Generator for Niagara Falls," by Mr. B. A. Behrend, chief electrical engineer of Allis-Chalmers Company, Milwaukee. Description of a 6500-kw generator installed in the plant of the Niagara Falls Hydraulic Power & Manufacturing Company, which is notably interesting both on account of its high e.m.f. of 12,000 volts and its high speed of 300 r.p.m.

"The Relative Proportion of Copper and Iron in Alternators," by Mr. Carl J. Fechtheimer, assistant electrical engineer, Allis-Chalmers Company, Milwaukee, Wis. A method is developed for determining what value of field flux to employ in order to obtain the cheapest machine.

"Application of Fractional-Pitch Winding to Alternating-Current Generators," by Mr. Jens Bache-Wiig, engineer, Westinghouse Electric Manufacturing Company, Pittsburg, Pa. Deals briefly with the advantages of the chorded-winding for alternating-current generators from the standpoint of manufacture and design, and indicates the influence this winding has on the performance of a machine.

"Voltage Ratio of Split-Pole Converters," by Prof. Comfort A. Adams, Harvard University, Cambridge, Mass. Gives a theoretical analysis showing that the field distortion of a split-pole synchronous converter does not necessarily involve electromotive force distortion.

"Induction Motors for Multispeed Service with Particular Reference to Cascade Operation," by Mr. H. C. Specht, engineer, Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Contains a mathematical treatment of the operating characteristics of two motors joined in "cascade."

ELECTRIC RAILWAY.

"The Determination of the Economic Location of Substations in Electric Railways," by Mr. Gerard B. Werner, engineer, Muralt & Co., New York. A formula is developed for determining the most advantageous location of substations so as to render the total annual charges on the installation a minimum.

"From Steam to Electricity on a Single-Track Road," by Prof. J. B. Whitehead, Johns Hopkins University, Baltimore, Md. Contains a description of the Annapolis Short Line, and an outline of the reasons for changing from steam to electricity.

"Conductor-Rail Measurement," by Mr. S. B. Fortenbaugh, engineer, General Electric Company, Schenectady, N. Y. Reports tests of the effects of reversing the polarity on "third" rails of the Underground Electric Railways Company of London.

HIGH-TENSION SYSTEMS.

"Fundamental Considerations Governing the Design of Transmission-Line Structures," by Mr. D. R. Scholes, chief engineer, Aermotor Company, Chicago, Ill. Deals with the mechanical problems involved in determining the strength of the various parts of steel towers, etc.

"Tests with Arcing Grounds and Connections," by Mr. Ernst J. Berg, engineer, General Electric Company, Schenectady, N. Y. Outlines a series of tests on a 25-cycle system at 33,000 volts, with various transformer and arrester connections.

"High-Voltage Experiments at Niagara," by Mr. Ralph D. Mershon, consulting engineer. Describes experiments made on the lines of the Niagara Falls Hydraulic Power & Manufacturing Company, to supplement the earlier tests at Telluride.

"Standard Tests for High-Voltage Line Insulators," by Mr. C. E. Skinner, engineer, Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Records the information obtained from various sources with a view to producing a standard specification for line insulators.

"Measurements of Lightning, Aluminum Lightning-Arresters, Earth Resistances and Kindred Tests," by Prof. E. E. F. Creighton, engineer, General Electric Company, Schenectady, N. Y. Describes the instruments and methods used and the data collected during two years' study of lightning phenomena, together with a discussion of the theory and practice of lightning protection.

"Engineering Features of the Southern Power Company System," by Mr. J. W. Fraser, assistant chief engineer, Southern Power Company, Charlotte, N. C. Shows how the conditions governing the sale of energy affected the design of the system, which is described together with certain proposed extensions.

OPERATION.

"The Application of Storage-Batteries to the Regulation of Alternating-Current Systems," by J. Lester Woodbridge, chief

engineer, Electric Storage Battery Company, Philadelphia, Pa. Outlines the general functions of a storage battery in connection with an alternating-current system, and describes the battery booster, the carbon-regulator, the split-pole synchronous converter and a variable-voltage exciter for boosters or synchronous converters.

RALPH W. POPE, *Secretary.* | L. A. FERGUSON, *President-Elect.* | GEO. A. HAMILTON, *Treasurer.*

EXECUTIVE OFFICERS-ELECT.

"Steam Turbine Plant; Some Possibilities Resulting from Recent Engineering Developments," by J. R. Bibbins, engineer, Westinghouse Machine Company, Pittsburg, Pa. Presents in a general way some of the engineering features of the double-deck steam-turbine generating station. Gives data and calculations based upon actual operation of the service plant of the Richmond (Va.) works of the American Locomotive Company.

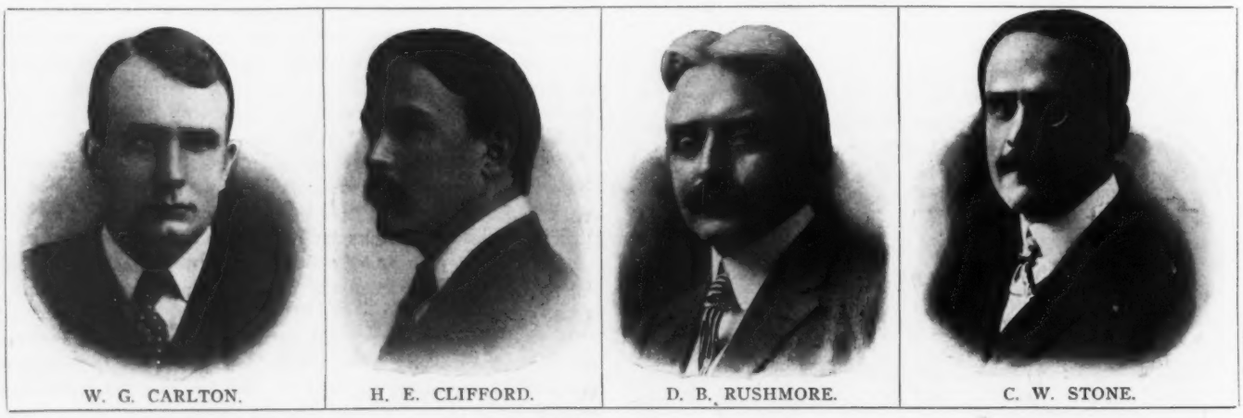
C. C. CHESNEY. | B. GHERARDI. | CALVERT TOWNLEY.

VICE-PRESIDENTS-ELECT.

ENGINEERING PRINCIPLES.

"Three-Phase Power-Factor," by Mr. Austin Burt, superintendent, Citizens' Gas & Electric Company, Waterloo, Ia. From the various relations that exist between electromotive forces and currents in a three-phase delta-connected system, the author derives a general expression that will enable the mean power-factor to be determined when the system is unbalanced.

"Graphical Treatment of the Rotating Field," by Mr. R. E. Hellmund, engineer, Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Diagrams are developed by means of which nearly all the phenomena of the rotating field may be



W. G. CARLTON. | H. E. CLIFFORD. | D. B. RUSHMORE. | C. W. STONE.

MANAGERS-ELECT.

"Thirty-Day Test on Producer-Gas Plant; Discussion of Results in Relation to Cost of Energy," by Mr. J. R. Ribbins, engineer, Westinghouse Machine Company, Pittsburg, Pa.

easily studied and the various factors necessary for the calculation of fluxes, exciting current, etc., may be determined.

"The General Equation of the Electric Circuit," by Dr. C. P. Steinmetz, consulting engineer, General Electric Company, Schenectady, N. Y. Deals with a mathematical investigation of the phenomena which may occur in the most general case of an electric circuit, giving practical interpretation to the mathematical equations.

"A Minimum-Work Method for the Solution of Alternating-Current Problems," by Dr. Harold Pender, electrical engineer, New York City. Describes a method of solving alternating-current problems by the use of certain factors based on trigonometric relations rather than on physics. The treatment is mathematical but the equations are fully interpreted.

"Notes on the Electric Heating Plant of the Biltmore Estate," by Mr. Chas. E. Waddell, electrical engineer, Biltmore Estate, Biltmore, N. C. Describes the hot-water system and laundry equipment, giving data relating to operating costs.

EDUCATIONAL.

"Relation of the Manufacturing Company to the Technical Graduate," by Mr. Magnus W. Alexander, General Electric Company, Lynn, Mass. Outlines the student course given at the Lynn Works of the General Electric Company, and proposes a plan by which a student becomes an apprentice in the factory during part of each year.

"Relation of the Manufacturing Company to the Technical Graduate," by Mr. B. A. Behrend, chief electrical engineer, Allis-Chalmers Company, Milwaukee, Wis. Pleads for close co-operation between the manufacturing companies and the colleges in order to cultivate both character and intellect in the graduates.

"Relation of the Manufacturing Company to the Technical Graduate," by Mr. D. B. Rushmore, engineer, General Electric Company, Schenectady, N. Y. Points out the necessity of co-operation in modern industrial establishments and suggests more co-operation between engineering schools and the manufacturers for their mutual benefit.

MISCELLANEOUS.

"The Measurement of Rotary Speeds of Dynamo Machines by the Stroboscopic Fork," by Dr. A. E. Kennelly and Mr. S. E. Whiting, Harvard University, Cambridge, Mass. Calls attention to what has already been accomplished by others in measuring rotary speeds with the stroboscopic fork, and describes a certain modification which has been developed by the authors.

"Wireless Telephony," by Mr. R. A. Fessenden, electrical engineer, National Electric Signaling Company, Washington, D. C. Gives a brief history of the development of wireless signaling, and outlines the future possibilities of wireless telegraphy.

"A Study of Multiple-Office Automatic Switchboard Telephone Systems," by Mr. W. Lee Campbell, assistant superintendent, Automatic Electric Company, La Grange, Ill. Shows how the enormous economic waste involved in manually-operated telephone systems may be greatly reduced in systems employing automatic switchboards.

"Primary Standard of Light," by Dr. C. P. Steinmetz, consulting electrical engineer, General Electric Company, Schenectady, N. Y. Suggests a standard based upon the physiological effect.

"Water Power Development in the National Forests: A Suggested Government Policy," by Mr. F. G. Baum, consulting engineer, San Francisco, Cal. Describes a method for determining a proper and fair charge to be made by the government for water-power development based upon the cost of maintaining the area benefiting by the privilege.

"An Imperfection in the Usual Statement of the Fundamental Law of Electromagnetic Induction," by Mr. Carl Hering, consulting engineer, Philadelphia, Pa. Discusses the "looping" theory versus the "cutting" theory of the production of electromotive force by the change in the interlinkage of flux and conductors.

CURRENT NEWS AND NOTES.

NEW YORK CENTRAL ELECTRIFICATION NEARLY COMPLETED.—The New York Central and the New Haven roads have announced that the electrification of their lines within the limits of the Metropolitan district will be completed by July 1, and that after that date no steam locomotives will be run through the tunnel.

TELEGRAPH COLLEGE IN CHINA.—Further information in regard to the establishment of a postal and telegraph college in China states that the board of posts and communications has sent a memorial to the Throne, asking for an appropriation of about $46,600 gold for the maintenance of the college. The school will be under the instruction of experienced foreign and Chinese teachers, and will instruct and train young men for service in all postal and telegraph departments.

ELECTRIC MOTORS IN MINES.—In an address on "The Choice of Electric Motors for Mine Equipment" recently delivered by Mr. A. W. K. Peirce before a meeting of the South African Association of Engineers, held at Johannesburg, the most suitable induction motor for general use was stated to be one running at as high a speed as consistent with its size, at a voltage not exceeding 400 and on a circuit having a frequency of 50 cycles per second. He confined his attention to the three-phase motors of the induction type, and said that certain special applications of electric power, or the limitations imposed by the existing systems of supply, might occasionally render the employment of other types necessary, but such circumstances would only be found to be exceptional.

NATIONAL RESOURCES COMMISSION APPOINTMENTS.—President Roosevelt has appointed a National Commission to consider and advise him on questions relating to the conservation of the natural resources of this country, and to co-operate with similar bodies which may be designated by the several states. The commission is divided into four sections; namely, waters, forests, lands and minerals, each having a membership of 12, mostly members of Congress and government officials. Among the few members from civil life are President Charles Macdonald and Prof. Geo. F. Swain, of the Society of Civil Engineers, and President John Hays Hammond, of the Institute of Mining Engineers. There are no representatives of the Electrical or Mechanical engineers.

EFFECTS OF EXTERNAL FIELDS ON METERS.—A point often lost sight of in the location of meters on switchboards was brought out in the committee report on meters before the National Electric Light Association. A busbar carrying a current of 600 amp at a distance of 12 in. from a direct-current meter was found to affect the accuracy of the meter at one-tenth load over 50 per cent, the direction of the current in the busbar determining whether the meter was fast or slow. The relative position of the busbar to the meter was accountable for the error, as the same current with a busbar 2 in. from the meter had no appreciable effect. A case was cited from actual practice where a 600-amp direct-current meter in excellent condition would not register on a load of 80 amp on account of the opposing field from an adjacent conductor. In another instance a 150-amp meter registered only 90 per cent of the load passing. Meters may also be influenced by their own wiring if the service or load wires are brought around the meter, and somewhat by their proximity to each other. The middle meter of three direct-current meters placed side by side 12 in. between centers was affected from 5 per cent to 10 per cent on one-twentieth load, when the other two carried a full load. Meters should be spaced at least 15 in. centers to be free from such effects. While the instances cited are all from direct-current practice, some makes of alternating-current meters are similarly affected by external fields. Errors such as those mentioned could be avoided by a judicious location of the meters.

ELECTRIC POWER FROM COAL WASTE PRODUCTS.—The town of Amherst, Nova Scotia, is supplied with electric power and light generated from the waste products of a coal mine. This accords with Mr. Edison's prophecy that the future site of electric generation would be at the pit's mouth.

PATENTS IN JAPAN.—It is stated officially that a treaty will be made and put in force between Japan and the United States, whereby American patents, trade-marks and copyrights will hereafter be given protection in Japan, so that they can no longer be appropriated by merchants and manufacturers on the spot, to the injury of those to whom the original rights belong.

PORTLAND (ORE.) LIGHTING COMPANY COURTS PUBLICITY.—The Portland (Ore.) Railway, Light & Power Company has started the publication, as advertising in local newspapers, of a series of frank statements or talks taking the public into its confidence. These publications set forth the work accomplished by the company and the advantage to the people in using its service.

PARIS TO ELECTRIFY ITS RAILROADS.—It is reported that the steam railroads entering Paris are seriously considering the proposition of electrifying their lines for some distance out from the city into the suburbs, as in the case of railroads terminating in New York City. At present there are six railroads entering Paris, one of which, the Paris-Orleans road, is already electrified.

A CANADIAN TRIP is proposed by the Iron and Steel Institute of Great Britain at the invitation of the Canadian Mining Institute. The excursion will leave Montreal on Aug. 24 and will cross the continent by Canadian Pacific to British Columbia. While in the Dominion the party will visit nickel, copper and asbestos districts. It is believed that several members of the English body will avail themselves of this excellent opportunity to study the general mining development of Canada.

INSTITUTE OF METALS.—A movement was started in England recently to form a Copper and Brass Institute, and this has now taken form in an Institute of Metals, devoted to the nonferrous metals and their alloys. A meeting to discuss the subject has been arranged to be held on June 10, at the Institute of Mechanical Engineers, Westminster, at which a number of metallurgists and manufacturers will attend, as well as representatives of the marine engineers and shipbuilding industries.

KOREAN TELEGRAPH SYSTEM.—The telegraph business of Korea is increasing, according to Consul-General Thomas Sammons, of Seoul, although the number of telegrams sent abroad, not including those to Manchuria, shows a decrease following the abnormal activity during the period immediately after the war. The telegraph lines aggregate 6772 miles. American telegraph instruments are not generally used. There were 25 post and telegraph agencies and 50 telegraph agencies, with a large number of establishments on a smaller scale calculated to facilitate communication.

ALUMINUM CONSUMPTION.—More than seventeen million pounds (17,211,000) of metallic aluminum were consumed in this country during last year, according to Mr. W. C. Phalen, of the United States Geological Survey, whose statistical report on the production of aluminum and bauxite has just been published by the Survey as an advance chapter from Mineral Resources of the United States, 1907. This is an increase of 2,301,000 lb. over the consumption in 1906, which amounted to 14,910,000 lb. The great increase in domestic production predicted in the early part of 1907 was not realized, and the failure of the predictions is attributed by Mr. Phalen, in large part at least, to the falling off in demand toward the close of the year as a result of general business depression.

ELECTRICITY FROM PEAT.—Details for establishing in Ireland an electric plant to furnish current generated from peat gas, the first plant of its kind in Great Britain, were recently reported to a committee of the British House of Commons. Consul-General Robert J. Wynne, writing from London, says that the Dublin & Central Ireland Electric Power Company is seeking a franchise to supply electricity to portions of the counties of Dublin, Kildare, Queens and Kings, and have arranged to purchase 500 acres of peat bog in the district. Heretofore one of the main objections to the use of peat as a generating power was that it contained 90 per cent of moisture and the drying expenses were too great. The promotors of the new scheme intend to use a process common in Germany by which it is advantageous to retain 50 per cent of the moisture in the peat, thereby obtaining by-products, such as sulphate of ammonia, which, it is claimed, alone pays the cost of the peat.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY DEGREES.—The faculty of the Massachusetts Institute of Technology has just conferred the degree of Master of Science on three graduate students in the electrical engineering course—Mr. R. B. Anthony, who graduated from the University of Wisconsin; Mr. E. L. Moreland, who graduated from the Johns Hopkins University, and Mr. F. W. Willey, who graduated from Purdue University. Thirty-eight students, 10 of whom are already graduates of liberal arts courses and three are graduates of the mechanical engineering course of the Institute, have been granted the degree of Bachelor of Science in the electrical engineering course. Graduate fellowships for electrical engineering study during the next year have been granted to Mr. Walter S. Rodman, now instructor in electrical engineering at the Rhode Island Agricultural College, and H. S. Osborne, who graduates from the electrical engineering course of the Institute this year. Mr. Osborne has been elected Saltonstall Fellow in recognition of his unusual attainments as an undergraduate student. Professor Laws and Professor Shaad, of the Electrical Engineering Department, each spent several days during the spring intermission studying the methods of instruction in electrical engineering and related subjects at Cornell University.

ELECTRIC STREET CARS IN WARSAW.—The first electric street-car line in Warsaw commenced operation in April. This electric line succeeds horse-drawn cars introduced in 1881 by a Belgian company, which, in 1889, sold the system to the city in consideration of an annual payment of $175,000 until the expiration of the concession in 1916. In 1907 there were 304 cars in operation and passengers were charged 7 kopecks (3.6 cents) for the first class and 5 kopecks (2.5 cents) for second class for a distance not exceeding two miles. For the year 1907 a gross revenue of $839,052 was obtained. The changing from the horse-car to the electric system will not affect the wages of employees. The daily hours are from 7 in the morning until 11.30 at night, with intervals for meals. The drivers receive 62 to 67 cents a day and conductors 62 to 83 cents. Inspectors receive $30.90 to $41.20 per month. A building company appointed by the emperor carried on the reconstruction work, the principal private contractors being German electric companies. There will be 180 motor cars, and the power house has three turbo-generators of 1800 hp each, the voltage being 600 to 650. The syndicate which will manage the system has closed a contract with the city until 1922. The syndicate agrees to pay the city an annual sum of 402,200 rubles ($207,030) and 5½ per cent on the invested capital of about 7,000,000 rubles ($3,605,000). From these receipts the city will continue to pay 350,000 rubles per annum to the Belgian company up to the year 1916; after the expiration of this liability the income passes into the city treasury. Whatever surplus net profit remains after the payment to the city of the sum agreed upon is to be divided into equal parts between the city and the syndicate.

Hydro-Electric Development in Mexico.

THE Sultepec Electric Light & Power Company was incorporated under the laws of the State of New York in February, 1906. In April, 1908, the capital stock was increased to an authorized amount of $1,000,000 and a consolidated first mortgage authorized in the same amount; the mortgage being dated May 1, 1908, and the bonds running for a period of 50 years and bearing interest at the rate of 6 per cent per annum. The company has outstanding $600,000 of its capital stock and an equal amount of its bonds and is the

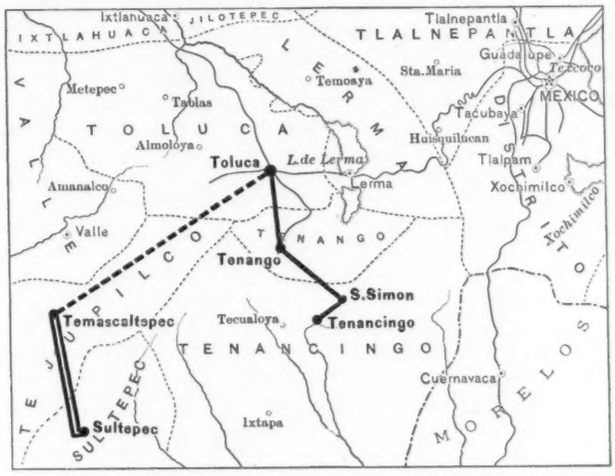


FIG. 1.—MAP OF TERRITORY SUPPLIED WITH ENERGY.

owner of two separate concessions in the Republic of Mexico. The newer concession was received from the Federal government and under it the company has the right to utilize a total of about 6000 hp, of which 2000 hp has been installed in the plant later described. This generating station, which is a thoroughly modern and up-to-date plant in every respect, began actual operations in December, 1907.

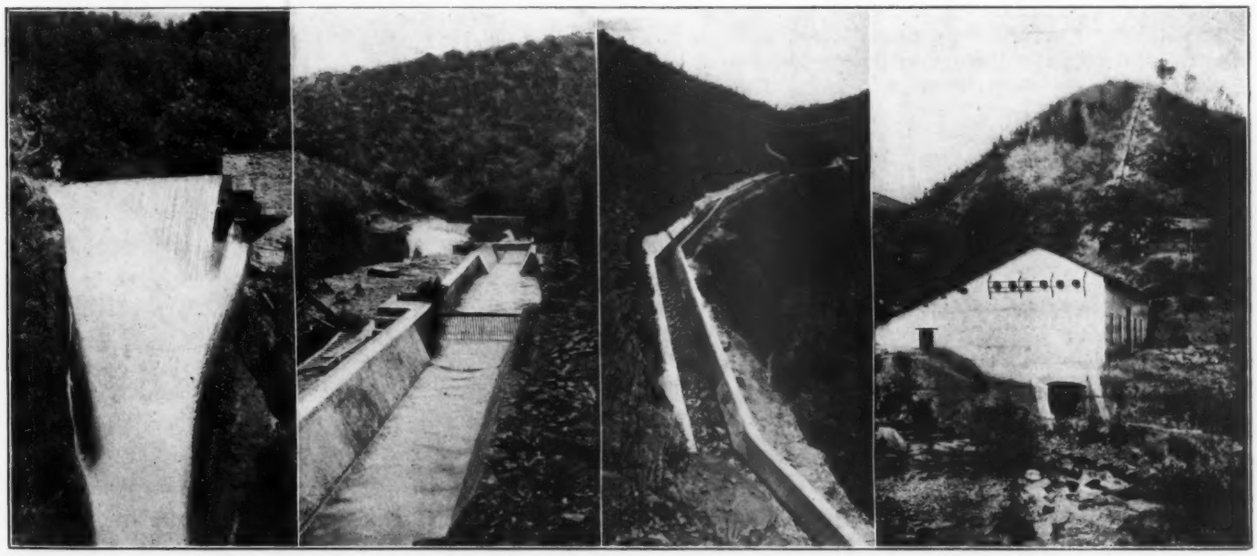
The company has also acquired by purchase the plant and property of the Toluca Electric Light & Power Company, which has been in successful operation since 1903, its total output approximating 1000 hp. A description of this plant also follows. The Sultepec Electric Light & Power Company has valuable contracts with the different municipalities through which its lines run, including a 10-year contract executed in 1907 with the city of Toluca and also contracts with local manufacturers and a number of important mines in the Sultepec district.

Some of Mexico's richest mining camps are in the State of Mexico, some 75 miles to the southwest of Mexico City, including Temascaltepec, Sultepec and Zecualpam. Much of the Montezumas' wealth came from these mines, which were among the first exploited by the Spaniards after the conquest. In recent years a large amount of American and other foreign capital has been invested in the development of the mines under modern and scientific methods, but the scarcity and high price of fuel for power purposes has become a great obstacle in the way of large development. In the neighborhood of Tamascaltepec much water is encountered in the mines and the ancient workings were abandoned when they reached a depth at which, with the crude appliances of those days, they could no longer keep them dry; one mine bears the suggestive name of Mina de Agua (Mine of Water).

THE SULTEPEC ELECTRIC LIGHT & POWER COMPANY.

Flowing by Tamascaltepec is the Rio Verde, with a minimum flow of 3 cu. m. (106 cu. ft.) of water per second and for many kilometers a fall of from 5 to 10 per cent, offering splendid opportunities for power development. This river has its source in the snow-clad ancient volcano of Xinantecatl, near Toluca; the summit of this mountain is 15,500 ft. above sea level and has a large lake in its extinct crater. The flow of water in the river is fairly constant the year around except during the rainy season, which lasts from June until November, when there are frequent floods of short duration. The Sultepec Electric Light & Power Company, of New York, has secured from the Mexican Federal government a concession for the use of this water, covering about 30 km (19 miles) in length of the river, and has just completed the installation of the first of several proposed power plants on it for furnishing energy to the mines in the above named camps. This first plant is located on the edge of the town of Temascaltepec and within a few kilometers of some of the largest of the mines, power for which is furnished directly at machine voltage without transformers. For Sultepec, 25 km southeast, and Toluca, 60 km northeast, transmission lines of 25,000 volts are established.

The river at the point where this development is made flows through a cañon eroded out of solid rock, from 10 to 30 m in depth and an average of 5 m in width. To raise the water from the river bed to the canal level, a masonry dam (Fig. 2) 17 m in height was built at a point where the cañon is from 4 to 5 m wide. The dam has a base 14 m and crest 1.86 m thick; at the bottom is a steel sluice pipe 36 in. in diameter with gate valve operated from the top of the dam. Two meters below



FIGS. 2, 3, 4 AND 5.—DAM, SAND TRAP, CANAL AND POWER HOUSE.

the crest of the overflow is another sluiceway 1 m wide by 1.50 m high, controlled by a wood gate operated by rack and pinion. The crest of the overflow is 1.50 m above the floor of the canal and the entrance of the water to the canal is through a 1 by 1 m opening also controlled by a wood gate.

The dam is built of random rubble masonry, part of which is laid in cement mortar and part in hydraulic lime mortar, and is reinforced by having a large number of steel rails embedded at intervals through it. The water was diverted to one side at the bottom of the gorge, while the sluice pipe and valve were built into the other side and the water then turned through the pipe. This pipe was designed to pass about 5000 liters (175 cu. ft.) per second, while the normal flow of the river is but

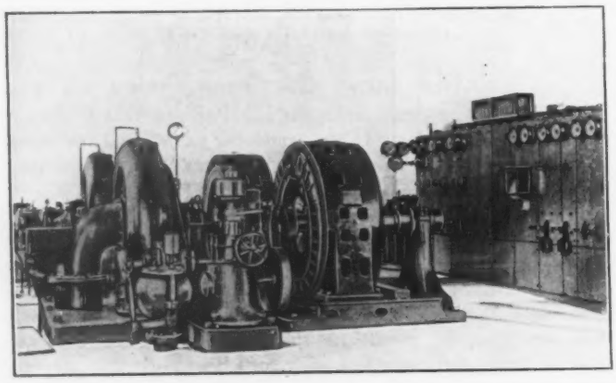


FIG. 6.—INTERIOR OF THE GENERATING STATION AT TEMASCALTEPEC.

little over 3000 liters during the dry season. Unfortunately a number of out-of-season floods occurred while the work on the dam was yet low, sweeping out the coffer-dam and some of the permanent work each time; this caused considerable loss of time, as well as extra expense. Since its completion it has withstood some extraordinarily heavy floods.

The canal has a total length of 1170 m, of which 920 m is excavated in hard clay and 250 m is blasted out of the face of the cañon, the entire length being lined with masonry laid in hydraulic lime mortar. The cross section is a half hexagon, 1 m wide at the bottom, 2.13 m wide at the top and 1 m deep, with a slope of 1 in 300. Fifty meters below the intake is a sand trap (Fig. 3) 2 m deep, 2½ m wide by about 20 m long, discharging into the river through a sluiceway 1 m by 1 m, controlled by a wood gate.

At the lower end of the canal is a settling basin (Fig. 9) 60 m long, 20 m wide and 3 m deep, divided longitudinally into two chambers and so arranged that water may be passed through either side while the other is being cleaned or may flow through both at the same time. For the purpose of cleaning the chambers, there is a sluiceway (Fig. 9) built under them and communicating with them through openings controlled by gates. On the river side of the entrance to the basins is an overflow of sufficient capacity to discharge the full flow of water into the river in case of emergency. From the settling basin a pipe line 42 in. in diameter and 254 m in length carries the water down to the power house, the total difference of level between the surface of the water in the settling basin and surface of the tail race being 104 m (341 ft.). At the bottom the pipe expands into a 54-in. receiver (Fig. 11) from which four 20-in. branch pipes carry the water to as many turbines. There is also one 8-in. branch for the exciter unit and an 8-in. blow-off pipe. On top of the receiver are three 6-in. relief valves. The pipe is of "Lock Bar" type, manufactured by the East Jersey Pipe Company. It is made up of 25-ft. lengths, joined together with riveted flanges. The receiver is 7/16-in. thick, and the pipe is ⅜ in., 5/16 in. and ¼ in. thick, respectively, from bottom to top. An air relief is provided in the masonry at the top just below the head gate.

The power house (Fig. 5) is of masonry, with steel truss roof covered with corrugated iron. The main building is 30 m long, 9 m wide by 6 m high; a room 3 m by 9 m is partitioned off at one end for an exit for the 25,000-volt lines and for lightning arresters and high-potential cut-outs. A workshop, 8 m by 9 m, is built as an L to the main building.

In the machinery room are four Pelton-Francis turbines direct-coupled to Westinghouse 400-kw alternators, generating three-phase currents at 2200 volts and 60 cycles. These turbines are guaranteed to produce 750 hp at an efficiency of 80 per cent and 550 hp at an efficiency of 82 per cent when running at a speed of 900 r.p.m.; tests made after installing them gave somewhat better results than the guarantees. The units are controlled by oil-pressure governors with by-pass relief valves. The exciter units consist of two 40-kw, 125-volt, 690 r.p.m. generators, one Pelton impulse wheel of 90-hp capacity and a three-phase, 60-hp induction motor, so arranged that either or both generators may be operated by the waterwheel, one of them may be operated by the induction motor and the other may be belted to one of the main generators, thereby giving two separate sources of power to each exciter generator.

The switchboard consists of nine panels of Florentine marble; one panel controls the exciter machines, four are for the four generators, one is a totalizing panel, one a feeder panel with provision for four circuits at machine voltage and two are transformer panels for controlling the low-tension sides of the step-up transformers. All wires to and from the board are in lead-encased cables carried through ducts under the floor. As a good portion of the load will be taken at machine voltage, only three step-up transformers, each of 400-kw rating, are at present provided (Fig. 8); but space is provided for a fourth unit should it become necessary.

The transformers are located at one end of the main generator room; they are oil-insulated, water-cooled and step-up the voltage from 2200 to 25,000 volts and will be connected either two in V or three in delta according to the demand for power over the high-voltage lines. The high-voltage leads of the transformers are connected through circuit-breakers to busbars mounted on the wall dividing the main room from the lightning-arrester room. On the opposite side of this wall, in the lightning-arrester room, are other busbars from which the outgoing circuits are controlled by circuit-breakers. The busbars on the two sides of the wall are interconnected by wires passing through 24-in. circular openings in the wall. Westinghouse low-equivalent lightning arresters and choke coils are connected to each outgoing wire through disconnecting

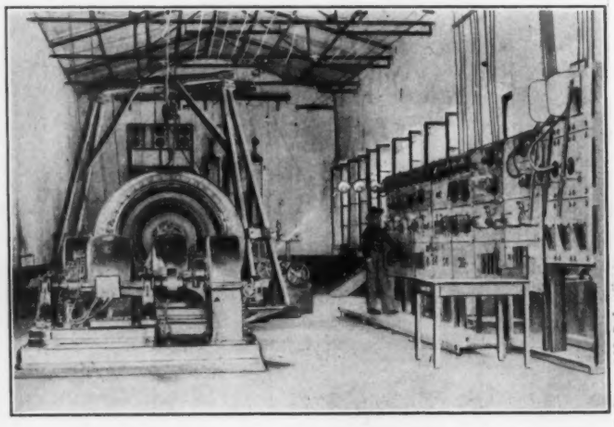


FIG. 7.—GENERATING STATION AT SAN SIMONITO

switches. From the lightning-arrester room the line wires pass out through 24-in. openings in the end wall of the building, being secured on the outside to heavy-strain insulators mounted on brackets.

Water for cooling the transformers is pumped from a well to a tank located just above the power house and from this tank to the transformers by gravity, or it can be taken directly from the pipe line. A 3-in. oil pipe runs from the bottom of each transformer case through the floor to a tank in the tail-race tunnel so that in case of fire in one of these transformers

the oil can be quickly emptied. A 5-ton traveling crane is mounted in the main room, which can be used for handling any machine or transformer.

The transmission line to Sultepec (Fig. 12) is 24 km long. Steel poles 35 ft. in length, of the Franklin Rolling Mill Company's tripartite type, are spaced 70 m apart. The cross-arms are of native oak, dried and immersed for five minutes in hot chapapote. The three wires of each circuit are arranged in an equilateral triangle, 70 cm apart, one circuit on each side of the pole, on two cross-arms. One circuit is transposed twice between Temascaltepec and Sultepec, making a complete turn;

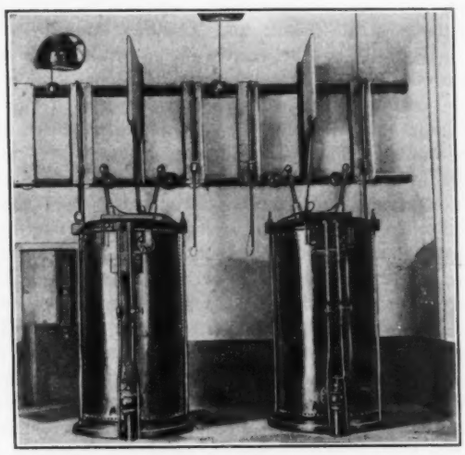


FIG. 8.—STEP-UP TRANSFORMERS AND CIRCUIT BREAKERS.

the other circuit goes through without transposition. No. 1 Provo type glass insulators are used, mounted on locust pins which have been boiled in oil. Two meters below the transmission wires telephone wires are placed on two-pin cross-arms, the wires being transposed on every fifth pole. Lightning arresters are placed on each wire entering the Sultepec substation and additional lightning protection is provided in a galvanized wire cable, 3/8-in. diameter, running along and grounded to the pole tops in those places where the line passes over high ridges, the wire being carried down each side of the ridge to where its ends can be buried in permanently wet earth.

At Sultepec a substation has been erected for stepping the voltages down to 2200 volts for distribution to the mines in that vicinity. The 25,000-volt line will later be continued to Zacualpam, about 25 km from Sultepec. At present the Sultepec substation is equipped with two 200-kw step-down transformers of the same type as the 400-kw transformers at the power plant, being connected in V on the three-phase busbars which can be connected to either or both of the incoming circuits. Water for cooling these transformers is brought by gravity from a large spring nearby. Provision is made in the station for installing more transformers as the demand for electricity may require.

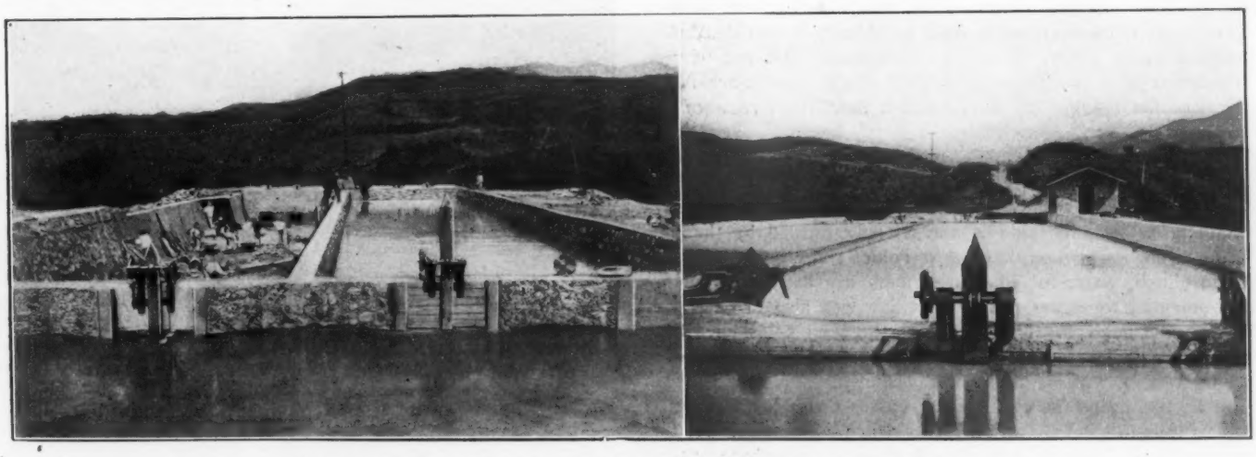
The machinery had to be carted over a mountain trail for a distance of 27 miles, passing over a ridge of over 11,000 ft. elevation, and from there dropping to an elevation of about 5000 ft. within 20 miles. Some of the poles had to be carried 10 to 12 miles by peons over trails impossible to carts.

A line is now under construction from Temascaltepec to Toluca, a distance of 60 km, at which place it will connect with the lines of the Toluca Electric Light & Power Company. This line will be a single three-wire circuit of No. 4 copper supported on the same kind of poles as those on the Sultepec line. On the west end of this line there are many deep but narrow barrancas which are crossed by spans of from 300 to 400 m, supported at each end on two poles placed about 3 m apart with double cross-arms between them supporting heavy strain insulators of porcelain.

The construction of the power plant was in charge of an American engineer, but the labor was practically all performed by Mexican peons, who are experts in the kind of masonry work used.

TOLUCA ELECTRIC LIGHT & POWER COMPANY'S STATION.

The Toluca Electric Light & Power Company's power plant, now owned by the Sultepec Company, is located at San Simonito, a small village 37 km southeast from Toluca. The river has its source in a large spring 6 km above the power house and is utilized by two other developments, one of 65 m and the other 105 m head, before it reaches the dam of the company. The dam is of rubble masonry laid in cement and is 3 m high, 2½ m thick at the bottom and 1½ m at the top; it rests on solid rock. The overflow sill is 18 m long. Three meters above and parallel with the dam, in front of the head gate, is a deflecting wall to protect the head and sluice gates from floods. During the rainy season, June to October, floods are of frequent occurrence, coming suddenly and with great violence, carrying an immense amount of mud, sand, boulder and trees. The canal is 1 km long, 1 m deep and 1½ m wide, with a total fall of 1 m. It is excavated in a hard, tough clay and is not masonry lined. There is a sand trap 200 m below the head gates and another 300 m below. One barranca 10 m wide and 8 m deep is crossed with a three-arch masonry flume, and another barranca, 8 m wide, is crossed with a single-arch masonry flume.



FIGS. 9 AND 10.—SETTLING TANK AND RESERVOIR AT HEAD OF PIPE LINE.

The canal discharges into a reservoir 20 m wide, 200 m long and 3 m deep, holding about a 4-hours' supply of water; it has two sluiceways for washing out the mud, which collects very rapidly in the rainy season. From the reservoir the water is conducted to the power house through a 28-in. riveted steel pipe, 675 m long, and with a total drop of 220 m (721.6 ft.). The minimum flow of water in the dry season is 750 liters per second.

The generating station (Fig. 7) is built of masonry with steel truss roof, covered with corrugated iron. It covers an area 8 m by 20 m, and is 6 m high. There are three Stanley inductor-type generators of 300-kw nominal rating, generating three-phase currents at 60 cycles and 6600 volts, the speed being 360 r.p.m. To each generator is direct coupled a Pelton impulse wheel, governed by Replogle relay governors, which deflect the water with a cut-off hood. Exciting current is supplied from a G. E. 40-kw, 56-volt generator driven by a small

FIG. 11.—PIPE LINE IN REAR OF STATION.

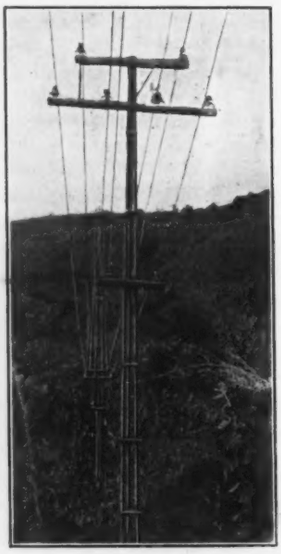


FIG. 12.—VIEW ALONG TRANSMISSION LINE.

Pelton wheel with hand regulation, there being two such generators, each with its own wheel. The circuits are controlled from a seven-panel marble switchboard equipped with Stanley hot-wire ammeters and voltmeters, indicating wattmeters and Bristol recording voltmeter. One circuit is taken at machine voltage to Tenancingo, 5 km, where it is received by two Stanley oil-insulated, water-cooled transformers, each of 150-kw rating. These transformers were intended for three-phase to two-phase connection at 2200 volts, but because there were no two-phase motors carried in stock in Mexico, it was decided to connect them in V, giving a three-phase 2200-volt circuit. There are also two General Electric 25-light series-arc transformers for feeding the lamps which light the streets of the town.

The transmission line to Tenancingo was originally of native pine poles, but as the life of these poles is not over a year, iron tubular poles are used, one wire on top and the other two on a wood cross-arm, the side of the triangle formed by the pine being 24 in. long. For the line to Toluca three 250-kw Stanley oil-insulated, water-cooled transformers are used, stepping up the potential to 27,500 volts. This line was also originally of native pine poles, but Franklin tripartite steel poles have been substituted in their stead. One three-wire circuit of No. 6 round copper wire is used. At Tenango, half way between San Simonito and Toluca, the line passes through a substation where it can be cut by an oil-break switch for testing. At this station is a General Electric oil-cooled, three-phase, 75-kw transformer, reducing the voltage to 2300 volts for local distribution; also two General Electric 35-light series-arc transformers which furnish energy for street lighting in Tenango and Calimaya, 6 km farther along the main line. A 2300-volt circuit is also carried to Calimaya and other small towns nearby for incandescent lighting and for operating small motors.

At Toluca the lines enter a substation containing three General Electric 200-kw and three 50-kw transformers stepping down to 2300 volts. Both the primary and the secondary circuits are controlled by hand-operated, oil-break switches. There are also three General Electric 25-light series-arc transformers, two of which are for street-lamp circuits and one for lighting a brewery, which also gets its energy for motors from the company. Besides the 50 General Electric arc lamps there are 60 arc lamps of German make, operating 30 in series on a 2300-volt constant-potential circuit. Energy for motors is also furnished to a large cotton mill and numerous small industries and a 2300-volt circuit runs to several nearby towns and ranches for supplying energy to lamps and motors. Lightning protection is furnished at the power plant by a set of Westinghouse low-equivalent arresters on the 27,500-volt line, and General Electric arresters on both ends of the 6600-volt line. There are also General Electric arresters on the 27,000-volt line in the substation at Toluca and Tenango and in two intermediate arrester houses between Tenango and San Simonito.

The line to Toluca was originally equipped with porcelain insulators, but after the steel poles were erected there were frequent interruptions during the stormy season caused by punctured insulators. The porcelain insulators have now all been replaced with No. 1 Provo type glass insulators, and the interruptions from line troubles have been almost completely eliminated. The Toluca plant has now been in operation five years, and although fully loaded has a constant demand for more energy. A call from the brewery for an additional 300 hp prompted the company to build a line from its power plant at Temascaltepec to Toluca, which it is now doing, and it will install in the Toluca substation three 220-kw General Electric transformers. The circuits will be so arranged that any set of transformers may be connected to either set of high-tension wires, and the distributing circuits will have double-throw switches so that any circuit may be fed from either set of low-tension busbars.

Toluca, capital of the State of Mexico, is located on the Mexican National Railroad, 73 km west of Mexico City, at an elevation of 8700 ft. It is the central point of an immense fertile valley, which is thickly populated and highly cultivated. The climate is mild the year 'round, being somewhat cooler than that of Mexico City. It was founded in the year 1120 by the Aztecs and now has a population of about 30,000. In Toluca is one of the largest breweries of Mexico, a cotton mill, flour mill and many smaller industries, all of which are

FIG. 13.—AQUEDUCT FOR PASSING SURFACE WATER OVER THE CANAL.

using electric energy for driving motors, and have entirely abandoned their steam plants.

The officers of the company are as follows: Mr. Henry Seibert, president; Mr. Timothy S. Williams, vice-president; Mr. R. J. M. Danley, second vice-president and general manager, Toluca, Mexico; Mr. Clinton L. Rossiter, secretary and treasurer. The directorate includes Messrs. Henry Seibert, Clinton L. Rossiter, German Roth, David H. Valentine, Timothy S. Williams, John Englis, Seth L. Keeney, Frederick S. Flower and J. L. Greatsinger.

Present Status of the Lightning Problem.

BY PERCY H. THOMAS.

EVERY year there is something added to the general sum of knowledge on the relation of lightning to the electric-power system. Sometimes it is a record of actual experience at a plant, sometimes a new laboratory investigation, or, occasionally, prearranged tests on a full-sized commercial system. Once in a while, once in a long while, it is a new theoretical or mathematical discussion of importance. This gradual accumulation of information has finally produced a relatively satisfactory and definite knowledge of the nature of this lightning arrester problem, although the best practical solution of a particular case is still often difficult. A periodical résumé and unification of the accumulated results is desirable. It is the purpose of the present article to make such a résumé. According to the writer's views, the ordinary action of lightning on an electric system is somewhat as follows:

For some reason, not necessary here to determine, the upper atmosphere is charged with positive electricity. This fact has been determined by actual measurement. For each element of positive electricity above in the air there is, of course, on the surface of the earth a corresponding element of negative electricity. These two attract each other as do other unlike charges of electricity and ultimately come together. These negative charges are presumably collections of ions, so much discussed at the present time in connection with radio-active substances and ionized gases. Such ions when free in the atmosphere collect about them molecules of air and dust, or, when such are available, probably accumulate as an electric charge on the small drops of water suspended in the clouds. At any rate, strong electric charges are scattered through the upper atmosphere and are constantly settling downward.

They are drawn downward in virtue of their attraction for the corresponding charges on the surface of the earth and by gravity, but are restrained by the resistance of the atmosphere. These ions are free to move about in the air, carried by whatever "aggregates" of molecules they may have collected or by drops of water in which they may have accumulated. But they move through the atmosphere only slowly, on account of its great resistance to their motion. They are also carried bodily about by the ever-present air currents.

In virtue of their mutual repulsion the ions tend further to become uniformly distributed throughout the whole space. Due to other more powerful forces, however, they become concentrated in certain regions, as they settle lower toward the earth. When the electric strain gets too great between such a region and a relatively uncharged region near by, a discharge will occur between them and a flash between clouds will be observed from the earth.

There is in addition to the two ways already mentioned by which the ions can move, namely, by passing bodily through the air or by being carried bodily with it, a third method—by a direct electrical discharge, the well-known lightning. The latter, of course, occurs only when the charges have become tremendously concentrated and relatively near the earth. Thus there exists here a novel condition of electric charge; not on a conductor and yet free to move, at least slowly, in obedience to the various forces acting upon it. This is the reason that such enormous accumulations of energy and potential may occur.

When the process of settling toward the earth and concentration of charge with its enormous resulting rise or potential has progressed for some time, there is formed a highly charged layer of water vapor at a relatively low altitude above the earth which balances a similar charge on the earth's surface. Conditions are then ready for the last stage, the lightning strokes proper. These occur, of course, when the potential between two points either in the clouds or between the cloud and earth becomes greater than the disruptive strength of the air between them can support.

In the usual case, when a storm follows a hot day, it is probable that the layer or strata of hot air formed by the rising air heated by contact with the surface of the earth, is overlaid by a heavier layer of cold air that has not been in contact with the hot earth, much in the way that a layer of oil may for the moment be made to support a layer of water on top. In this case the electric charges would be in the bottom of the cold layer. This is a condition of unstable equilibrium, as in the case of the water and the oil, and when the condition has become too topheavy, the cold air breaks through at some point and an overturn takes place. This brings the heavy charges into proximity with the earth and violent discharges of electricity suddenly occur, accompanied by the appearance of cold air and sudden gusts of wind. This overturning process once started in one place will proceed, producing like effects in other localities.

To return now to the charges which have finally worked downward into close proximity to the earth's surface. As any one highly charged region approaches near enough to the earth, a disruptive discharge passes to the nearest grounded object and neutralizes the charge on the earth's surface corresponding to the charge of this particular region. This region of air which thus discharges itself may be large or small and will produce a correspondingly large or small flow of electricity and of energy. When the region is very intensely charged, the discharge will probably spread through a much larger region of the air than when the concentration is relatively low. The discharge may even be only a brush discharge. The large discharges coming, perhaps, from regions thousands of feet or more in extent, do tremendous damage, while the smaller, relieving possibly not more than a hundred feet of air space, leave almost no trace on trees and lightning rods, the usual paths of lightning discharges. Frequently only a small strip of bark will be thrown off a tree trunk, as is often observed, as a matter of fact. In the discharge of the atmosphere by a thunder storm, there are probably very many of these small discharges for every one of the extremely heavy ones. Thus during the storm a large part of the charges of the air in a given region are gradually either discharged to earth or are swept away.

As a usual thing electric lines are not particularly exposed to the action of the descending charges and do not thus receive directly many of the discharges. These lines are lower than many trees and buildings and cover only a very small portion of the actual surface of a given region. They do, however, receive some and certain plants many more than others. The relatively extreme sensitiveness of the electric system to high-tension disturbances, however, renders the comparatively few and relatively light discharges actually received a most serious matter.

Wurts and others long ago called attention to the fact that an electric line could be disturbed without a direct discharge, through the slow accumulation of a charge on the line by leakage, in response to static induction from a charged cloud in the neighborhood and the abrupt lease of this charge by the discharge of the cloud. This action, of course, actually must take place, but it seems to the writer that it is probably not severe enough to do much damage, except perhaps in the case of a relatively small cloud very near the line. This conclusion is indicated by actual experience with transmission lines, in which, as a matter of fact, the disturbances are nearly always confined to a very definite and limited area, except, of course, for the subsequent resulting wave of charge sent along the line.

It has always been a mystery how such very long flashes of lightning as have been frequently recorded in photographs can be produced. Their length would sometimes seem to require almost unimaginable voltages, judging by the values of voltage discharge distances established in the laboratory. If the hypothesis of the accumulation of ions here put forward is correct, however, the difficulty is much reduced on account of the well-known action of the presence of ions in reducing discharge voltages in gases. It is now pretty generally agreed that current flows in an arc which has once been established, at least partly, through the agency of the ions or electrons liberated by the actual current and that the difficulty of getting the current through the air initially is due to the absence of such free electrons. Under the influence of relatively very low voltages in the arctual arc, the free electrons have the property of liberat-

ing others, and thus continuing the passage current, when once started. Now the presence of large qualities of ions in the atmosphere acts to a greater or less extent like the previous establishing of an arc and would thus greatly reduce the voltage necessary to produce a discharge; possibly to something like that ordinarily found sufficient to maintain an arc already started. On this basis 2,000,000 volts might in an extreme case start a discharge 1000 ft. long. This potential is not at all hard to accept. In bringing forward this suggestion the writer does not wish to distract attention from the generally accepted hypothesis that the length of the longest discharges is greatly extended by the step-by-step process. That is, a discharge to one region makes possible an immediate discharge to another, and so on.

To distinguish them from the induced effects, these atmospheric discharges striking a line or other object are called direct strokes. Their salient characteristic is the enormous concentration of charge they produce at a particular point of the system. Since these discharges must be from exceedingly high potential and through a path having relatively little inductance, they must be extremely sudden or abrupt; this is well known to be the actual case. It is known also both from theory and observation that such sudden discharges cannot be completely discharged through a ground connection of even a few yards in length, in view of its impedance, but the point of application must experience for an extremely brief instant of time the full strain in spite of such a ground connection. This means that absolute protection for the line itself cannot be obtained from lightning arresters unless they are placed at least every few poles, which is ordinarily out of the question. In other words, the discharge insists in taking the most direct path to earth. This much is established practically beyond controversy. This does not mean, however, that no strain at all is produced on the rest of the line, for a wave of charge is started in both directions along the line by each discharge. This wave starts at the potential reached by that point of the line where the discharge strikes. Fortunately, the wave is of much less energy than the original discharge on account of the limited static capacity of the line itself and of the limited voltage that can be withheld by the insulation of the line. These waves travel until they reach an arrester or other opportunity to discharge; their energy grows less and less as they proceed. This action may be likened to the formation of a wave in a long, narrow trough with high sides containing water and normally less than half full, by sudden flooding of the trough by a large quantity of water at some particular point; the excess water spills over and escapes from the trough at the point of the flood, but there is still a wave started in each direction as high as the sides of the trough will permit; this passes along until the end is reached or the energy of the wave is gradually dissipated. It makes no difference how much water is thrown into the trough, there can be a wave only as high as the sides will permit.

These traveling electric waves often reach a station and there will ordinarily be discharged without damage by the lightning arresters, if these are of proper design and the insulation of the apparatus is adequate. It is only in virtue of the relatively small energy of the wave, however, that the arrester, if it be a non-arcing type, can freely discharge the line. There has as yet not been produced an arrester capable of protecting apparatus against a direct stroke or a stroke in the immediate neighborhood.

The important characteristics of discharges of lightning in electric circuits are therefore as follows:

Concentration.—The discharge occurs at a very distinct location and is largely confined to the immediate neighborhood of this location, at least in the great majority of cases. Such extreme manifestations as the destruction of insulators, due to a single discharge, are rarely found over a distance greater than a mile in extent, usually much less. From this fact it may be concluded that practically no relief *for the line* is obtained from arresters at the stations.

Irresistible Character.—Many of the discharges are so severe that it is out of the question to insulate the line so heavily as to resist them. They must be expected to get to ground in the immediate neighborhood of where they strike. The higher the insulation of the line the more severe the waves that will travel along the line.

Abruptness.—The discharges are so sudden as to find a very high impedance in a short length of line and to form freely waves of static of relatively short length.

Wave Forming Power.—This has already been mentioned and is well understood.

Irregularity as to Location.—Ordinarily discharges may occur at almost any point, though they are much more frequent in some localities than in others.

From these characteristics may be drawn some inferences as to the protection of electric systems:

1. The best arresters should always be used to protect the circuits at all stations, as these circuits will be subjected to frequent waves of static from more or less distant disturbances, which waves can be handled with safety and without inconvenience by such arresters.

2. Where experience shows that particular locations are especially subject to discharges, as is often the case, unusual precautions can be taken to protect this portion of the system, as by additional arresters, overhead ground wires, etc., without entailing the prohibitive expense that would be required to protect the whole line as carefully.

3. In the protection of high-tension transmission lines, especially with the type of construction using grounded pin, the conditions are difficult. In the first place the discharges that must be expected occasionally to get to earth on account of their severity will often establish a short circuit on the system, which is much facilitated by the grounding of the pins, and either cause a shut down or great inconvenience. As the lines get longer and more widely spread, this result will occur oftener and oftener. If the strength of the insulators is made greater, then the discharge will be thrown with greater force into the traveling waves and thus be more dangerous to the stations. This latter condition of extreme wave intensity can be met by placing line arresters at points relatively close to the stations, to give a free discharge to these waves before they actually reach the station apparatus. This has not often been done, but will probably be found desirable more often in the future. One difficulty is the securing of a reliable line arrester that will discharge freely and yet cause no disturbance of the system and give no trouble when not under supervision.

Next to absolutely shielding the line from discharges altogether, the best solution, if any successful means can be found, is to permit the discharges to go to earth, wherever they may strike, but in such a manner as not to injure the insulator (that is presumably over its surface or through a separate gap) and to be so controlled as not to establish a short circuit. This would require some circuit opening apparatus for each discharge.

The method of protection of perhaps the most promise at the present time is the overhead ground wire. Of course, if a wire or wires is provided above the transmission lines which will first receive all the discharges and conduct them safely to ground, the whole problem is solved. The ground wire in its most successful form should theoretically accomplish this result. But it must not be assumed that a single wire put up in the most convenient manner and grounded here and there will accomplish this result. The matter is not so simple. The ground wire, or more probably the ground wires, must be so placed that they will receive ALL the discharges and will then conduct them to ground *without disturbing* the *lines themselves.* It must be remembered that the line voltage, as far as it is able, will tend to draw the discharge to itself away from the ground wire during negative voltage alternations, since the line potential is then added to the discharging potential. Also that the discharge from the air may come from any direction; it usually will not come straight downward, since there is almost always some horizontal motion of the air in a storm period, and this will cause the charged region to approach from the side. Thus, it is not an easy matter to make a single ground wire take discharges. A single ground wire may do much to relieve the strain, but a much more certain arrangement will

be two ground wires, one on each side of the line, to catch the discharges as charged regions approach from either direction. These wires should be well spaced from the line wires, and should be earthed as often as possible. The same condition which prevents a discharged wire from being relieved by an arrester at even a little distance, will prevent a ground wire from being effective, if the discharge has to pass more than a very short distance to reach the earth. The discharge will choose to jump to a transmission wire or to ground over some ungrounded pole, perhaps splintering it. It would seem to the writer that the only really safe plan would be to ground the wires at every pole. It is further necessary to carry the ground wires and the ground connections themselves well spaced from the transmission wires to avoid the side jumping of heavy discharges, for which there is a very strong tendency.

In cases where so elaborate a system of ground wires is not deemed warranted for the whole system, the line for a few miles from each station can be so equipped to great advantage, for thus will the station apparatus be amply protected from all discharges, even heavy ones, in its immediate neighborhood, while more distant disturbances can only send waves of static which can be handled by station arresters.

4. On low tension systems, especially distribution systems, conditions work out somewhat differently. Here the insulation of the line relatively to that of the apparatus is strong and the waves of static that are produced by discharges on the lines are, relatively, much more severe on the apparatus than in the high-tension plants. Further, the waves do not usually have so far to travel and hence do not lose so much of their energy. Thus a very good margin of insulation is required in the station apparatus, and arresters should be placed at frequent intervals and especially at all avenues of approach to any locations especially subject to lightning disturbance. Fortunately, low-tension lines are usually very much less exposed than high-tension, and low-tension arresters are rather more effective.

Nothing has so far been said of the static discharges that may arise within the system itself. These are of the general order of magnitude of the waves of static produced in lines by lightning discharges, only of less severity and in a well insulated and properly laid out plant will be cared for by the station arresters.

The protection of cable systems, which form a problem of a somewhat different character, has not been here considered.

As regards the best form of protective apparatus, conditions vary greatly in different plants and no general specifications can be laid down to be followed explicitly for all cases. There will be, however, in each case where satisfactory protection has not been secured, some relatively few steps to take to strengthen the protection, in general in more or less accord with the principles here laid down. In some cases better spacing and insulating of circuits will be required, in others perhaps an insulator having a greater discharge voltage. Another case may require an arrester with a better non-arcing power, and another a freer discharge to ground. The installation of an additional ground wire may be very helpful in many cases while in others it might be of little service. Critical trouble will often be found to be due to some defect in the insulation or supervision of the protective apparatus and not to the general plan of protection. This is usually easily remedied. Usually the best guide to the proper method of strengthening of a plant's lightning protection will be through a study of its previous experience. Consequently good records of all trouble should be always kept.

The object of this short article is to summarize and co-ordinate the conclusions to be drawn from the experience of operating engineers, the experiments of investigators and the deductions of the theorists interested in the solution of the problem of the protection of electric systems from lightning disturbances and more particularly to point out the fact that there now remains comparatively little uncertainty or mystery as to the nature of the lightning problem and that engineering experience and judgment may and should be used in the laying out of protective apparatus in exactly the same way as with other engineering problems.

Standardization Rules for Stationary Direct-Current Machinery in France, Germany, Great Britain and the United States.

BY A. E. KENNELLY.

THERE are various sets of standardization rules relating to electrical machinery, which have been drawn up and introduced in different countries. A set of such rules was adopted in the United States, in 1899, by the American Institute of Electrical Engineers.[1] This set was revised and extended in 1902[2] and again in 1907.[3]

Another set was adopted in Germany by the Verband Deutscher Elektrotechniker at its Dresden convention in 1901, and revised in 1902 and 1903. This set has been published in book form in Germany[4] as recently as 1908, and a translation of it has been published in France.[5]

A third set was adopted in France, in 1904, by L'Association Alsacienne de Propriétaires d'Appareils à Vapeur, entitled "Regles pour les Offres, la Fourniture et les Essais des Machines Electriques et Transformateurs" prepared by the French Association of Owners of Steam Plants with Electric Service (Amiens, Lyon, Marseilles, Nancy); the Association of Manufacturing Industries of Northern France (Lille), and the Norman Association for the Prevention of Industrial Accidents[6] (Rouen). This set was revised in 1906.

A fourth set was adopted in France in 1905 by "Le Syndicat Professionel des Industries Electriques" at Paris and entitled "Instructions Générales pour la Fourniture et la Réception des Machines et Transformateurs Electriques."

A fifth set was issued in Great Britain, in 1907, by the Engineering Standards Committee, supported by the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Naval Architests, the Iron and Steel Institute and the Institution of Electrical Engineers. It is entitled "Report on British Standards for Electrical Machinery."

It was in view of the growing divergence between the standardization rules for electrical machinery in different countries that the chamber of delegates of the International Electrical Congress of St. Louis, in 1904, adopted the resolution "that steps should be taken to secure the co-operation of the technical societies of the world, by the appointment of a representative commission to consider the question of the standardization of the nomenclature and ratings of electrical apparatus and machinery."[7]. The International Electrotechnical Commission has since been formed, and has held its first meeting, in London, in 1906. At that meeting a preliminary organization was adopted, but no discussion of standardization rules was reached. It is hoped that this international electrotechnical commission may accomplish results that will be of benefit to the cause of international electrical engineering.

In order to compare, in outline, the provisions of the standardization rules thus far adopted in France, Germany, Great Britain and the United States, the writer has drawn up the accompanying table. In order to keep the table within reasonable compass, only stationary direct-current machines have been included. Stationary direct-current generators and motors are, perhaps, the simplest machines to compare and to bring to a common basis of standardization, if only for the reason that the difficulty of diversity in alternating-current frequencies is avoided.

Column I in the table describes the property or qualification for the machines under consideration. Column II gives an abstract of the French rule in the set adopted by the S. P. I. E.

[1] Report of Committee on Standardization. *Trans.* A. I. E. E., Vol. XVI, p. 255, June, 1899.
[2] Report of Committee on Standardization. *Trans.* A. I. E. E., Vol. XIX, p. 1075, June, 1902.
[3] Report of Committee on Standardization. *Trans.* A. I. E. E., Vol. XXVI, p. 1076, June, 1907.
[4] *Normalien fur Bewertung und Prüfung von Elektrischen Maschinen und Transformatoren. Herausgegeben vom Verband Deutscher Elektrotechniker.* J. Springer, Berlin, 1908.
[5] *Règles Normales de l'Association des Electriciens Allemands pour la Comparison et l'essai des Machines et Transformateurs Electriques,* traduit par Loppé et Thouvenot, Paris, 1906.
[6] *Eclairage Electrique.* Vol. 41, 1904, pp. 479 and 518.
[7] *Trans.* Int. Elect. Congress of St. Louis, Vol. I, p. 46.

Comparative Analysis of Standardization Rules, in Different Countries, for the Rating of Stationary Direct-Current Generators and Motors.

	FRANCE (S. P. I. E.)	GERMANY (V. D. E.)	GREAT BRITAIN (E. S. C.)	UNITED STATES (A. I. E. E.)
1. Name plate on machine.	Called for, and required to state the power which the machine is to furnish, for generators in kw., for motors in hp. of 75 or poncelets of 100 kgm. per sec.	Called for, and required to state the power of the machine, the speed, current, terminal voltage and type of service.	Called for and required to state for generators. KW. output, volts, amp., r.p.m. Motors: Brake-hp, volts, amp., r.p.m.	Recommended. Should state maker's name, the voltage and the current. Where practicable, the kilowatt rating, speed, type, designation and serial number should be added.
2. Types of service recognized.	(1) Continuous. (2) Intermittent.	(1) Continuous. (2) Intermittent { For long periods. / For short periods.	(1) Continuous (excluding, however, machines working from week end to week end without stop). (2) Intermittent.	Continuous.
QUALIFICATIONS UNDER RATED LOAD. 3. Commutation.	Brushes of generators should be kept in fixed positions without sparking under rated load.	Should operate for at least 24 hours without requiring treatment of the commutator.	The wearing depth of a commutator, or the radial depth by which the commutator may be reduced before requiring renewal, to be 3/8 in. for commutators up to 4 in. in diam., ½ in. for 4-6 in. diam., 5/8 in. for 6-9 in. diam., ¾ in. for 9-12 in. diam., 1 in. for 12-18 in. diam., 1¼ in. for 18-24 in. diam., 1½ in. above 24 in.	
4. Regulation of voltage in generators.		At rated load excitation and at constant speed, the terminal voltages should be observed at four equidistant loads from no load to rated load. The maximum difference between these voltages is the drop in terminal pressure, the brushes being adjusted according to need.		To be measured by the ratio of the maximum variation of terminal voltages from the normal régime between no load and rated load, to the normal rated load voltage.
5. Regulation of speed in motors.	Speed variation to be measured when passing from rated load to no load under constant terminal voltage.		Speeds required for standard motors at rated load and with 220 volts up to 2 brake-hp and 440 volts above that size: Brake hp. — R.p.m. — Brake hp. — R.p.m. ¼ ..... 1600 — 15 ..... 850 ½ ..... 1400 — 20 ..... 800 1 ..... 1400 — 30 ..... 750 2 ..... 1100 — 40 ..... 700 3 ..... 1100 — 50 ..... 650 5 ..... 1000 — 75 ..... 600 7½ ..... 1000 — 100 ..... 550 10 ..... 900 —	To be measured by the ratio of the maximum variation in speed from the normal régime between no load and rated load, to the normal speed at rated load.
DIELECTRIC STRENGTH. 6. Test made.	Only on acceptance of machine and with the machine either hot or cold.	At factory, or, with large machines, in the plant before being placed in service, at normal temperature of operation.		With the completely assembled machine, before being put in commercial service, at temperature of normal operation.
7. Testing voltage.	Double normal pressure up to 3000 volts of normal terminal pressure; but with not less than 500 volts. Testing voltage to be alternating.	Double normal pressure up to 5000 volts of normal terminal pressure; but with not less than 100 volts. Testing voltage, direct. If the testing voltage is alternating, the maximum cyclic value is to be double the normal pressure, as above; so that the effective value of the testing voltage will be 1.41 times the normal terminal pressure of the machine under test.		Rated terminal voltage — Rated output. — Testing a.c.-voltage effective. Not exceeding 400 ..... Under 10 kw — 1000 Not exceeding 400 ..... Over " — 1500 400 and over; less than 800 ..... Under 10 kw — 1500 400 and over; less than 800 ..... Any — 2000 800 and over; less than 1200 ..... Any — 3500 1200 and over; less than 2500 ..... Any — 5000
8. Points of application.	Between the windings and the frame as well as between the different windings.	Between each winding and all the others as well as the frame, successively.		Successively between each electric circuit and all other electric circuits, including the conducting material in the apparatus.
9. Time of application.	Two minutes.	Thirty minutes.		One minute.
10. INSULATION RESISTANCE.		Measurement not considered as useful.		Measurement of secondary importance only. Should be such that the leakage current under rated voltage shall not exceed 1/1,000,000 of the rated load current; 1 megohm usually sufficient.
HEATING. 11. Duration of test.	kw. / r.p.m. — Time in hours. 0-10 — 2 10-30 — 3 30-100 — 4 100-200 — 5 200-300 — 6 300-500 — 7 500-700 — 8 700-1000 — 9 Over 1000 — 10 For machines of intermittent service, half of the time thus specified.	For machines of brief period service, for the time stated on the name-plate. For machines of intermittent service, for one hour. For machines in continuous service, 10 hours' continuous run, except in cases of small machines, when a shorter period may suffice.	Six hours for continuous working machines. One hour for intermittent working machines.	Sufficiently long run to enable apparatus to reach practically constant temperature. This period may be reduced by commencing with overload current. For machines of intermittent service a period corresponding as nearly as possible to conditions of service.
12. Standard temperature of surrounding air.	35° C.	35° C.	Not to exceed 25° C. (77° F.) in actual service.	25° C.

13. Correction for deviation of temperature from standard.			If the air-temperature of the room in which machine is to be used be t° and may exceed 25° C., then the temperature elevations allowed are to be reduced by (t — 25°).	Observed temperature rise to be reduced by $\frac{t - 25}{2}$ in per cent, if t be the actual room temperature.
14. Correction for change of temperature during test.	Mean temperature of surrounding air during last quarter of test.	Mean temperature of surrounding air during last quarter of test.		
15. Standard barometric pressure.				760 mm. of mercury.
16. Correction for deviation of pressure from standard.				Observed temperature rise to be reduced by $\frac{760 - p}{10}$ in per cent, if p is a barometric pressure materially differing from 760 mm.
17. Mode of measuring temperature rise.	By thermometer on hottest parts of machine.	All parts of machines, except exciting windings carrying direct-current and stationary windings, by thermometers, allowed to reach their maxima. All direct-current exciting windings and stationary windings by increase of resistance.	Windings by resistance whenever practicable. When not practicable, by applied thermometer or thermocouple. Commutators, brushes, bearings, etc., by thermometer.	In electric conductors, by increase of resistance when possible. When a thermometer indicates a higher rise of temperature than the change of resistance, the thermometer reading is to be accepted. Parts of machines other than windings, by thermometer.
18. Temperature coefficient of resistivity in copper.		0.4 per cent per deg. C., from room temperature, when not specially determined.	0.42 per cent per degree C. from and at 0° C.	0.42 per cent per degree C. from and at 0° C.
19. Limiting permissible elevation of temperature.	Field magnet winding..... 45°C Other direct current circuits..... 45°C Short-circuited windings ..... 60°C Commutators ..... 55°C Iron parts containing windings..... 60°C Bearings ..... 40°C Commutating machines to operate night and day 5°C less than the above in all parts.	Rotating windings insulated with cotton ..... 50°C Rotating windings insulated with paper ..... 60°C Rotating windings insulated with mica 80°C Stationary windings insulated with cotton ..... 60°C Stationary windings insulated with paper ..... 70°C Stationary windings insulated with mica ..... 90°C	For machines in which the insulating materials are of cotton, paper, linen, micanits or the like: Stationary coils, by resistance..... 60°C Moving coils, by resistance..... 60°C Moving coils, if by thermometer or thermocouple ..... 50°C For machines in which special insulating materials are used, designed to resist high temperatures, special extra temperature elevations may be allowed.	Field and armature..... 50°C Commutator and brushes, by thermometer ..... 55°C Bearings and other parts of machine, by thermometer..... 40°C Large machines with considerable overload rating, somewhat less than the above.
EFFICIENCY. 20. Methods of measurement.	By measurement of losses when measurement by input-output tests is inapplicable.	(1) Direct electric method or motor-generator input-output method. (2) Indirect electric method or motor-generator method, with measurement of losses. (3) Method of mechanical brake, applicable to small machines. (4) Method of electrical brake. (5) Method of losses without auxiliary motor. (6) Method of losses with auxiliary motor. (7) Method of engine indicator diagram for direct-coupled steam-driven generators.		(1) By input-output measurements. (2) By measurement of losses. (The former is usually applicable only to small machines.)
21. Enumeration of losses.	MECHANICAL LOSSES. (1) Bearing friction and windage. (2) Brush friction. ELECTRICAL LOSSES. (1) Hysteresis and eddy currents. (2) Joulean losses in windings. (3) Brush contact losses. The losses of auxiliary parts such as rheostat, exciter, ventilators and circulation pumps to be included. The efficiency may be determined both with and without auxiliaries.	(1) Windage. (2) Bearing friction. (3) Brush friction. (4) Hysteresis. (5) Eddy currents. (6) Copper losses. (7) Brush contact losses. Losses of power in belts to be excluded.		(1) Bearing-friction and windage. (2) Molecular magnetic friction and eddy currents. (3) Armature-resistance losses. (4) Commutator-brush friction. (5) Brush and brush-contact resistance. (6) Field excitation loss. (7) Load losses. Loss of power in belts excluded. In direct-driven generators inseparable from their prime movers the bearing friction is excluded. The loss in exciters or auxiliary machines should not be charged to the principal machine, considered separately; but should be charged to the plant consisting of principal machine, plus auxiliaries.
OVERLOAD CONDITIONS. 22. Limits of overload to be carried without injury.	In motors and generators for continuous service, 20 per cent during 1/10 of duration of heat run; 30 per cent for 5 minutes. In motors for intermittent service, 25 per cent for 15 minutes; 50 per cent for 5 minutes.	Generators and motors, 25 per cent for one-half hour. Motors, 40 per cent for 3 minutes.		In generators, 25 per cent for 2 hours. In motors, 25 per cent for 2 hours; 50 per cent for 1 minute.
23. Overload temperature elevation limits.		Temperature elevations not to exceed those stated for rated load. Overload tests not applicable after these limiting temperatures have been attained.	In all cases the temperature rise observed at the time of test must be such that the mean temperature of the machine, when in actual service, cannot exceed 85° C.	15° C. above those for rated load and after the application of rated load heat test.
24. Regulation.	Motors should be capable of sustaining 50 per cent excess in speed above normal for 5 minutes.	Generators should be capable of maintaining normal terminal voltage with 15 per cent overload.		
25. STANDARD VOLTAGES.		For generators, at terminals—115, 230, 470, 550 volts. For motors, at terminals—110, 220, 440, 500 volts.	For generators, at terminals—115, 230, 460, 525 volts. For low-voltage distribution circuits—110, 220, 440, 500 volts.	For generators, at terminals—125, 250, 550-600 volts. For low-voltage distribution circuits—110, 220 volts.

(Syndicat Professionel des Industries Electriques) already referred to. As already pointed out, there have been two sets of rules adopted in France; only one has been selected, however, in order to keep the table within reasonable limits of space. The set adopted by the Paris Syndicate has been taken in preference to the set adopted by the *Association Alsacienne*, although the latter set may be, perhaps, more generally employed. The two French sets do not, however, differ widely in their respective provisions.

Column III gives an abstract from the German rules of the V. D. E. (Verband Deutscher Electrotechniker), according to the 1908 edition above referred to.

Column IV gives a corresponding abstract from the rules in Great Britain of the E. S. C. (Engineering Standard Committee), according to the 1907 edition.

Column V gives an abstract from the corresponding rule of the United States A. I. E. E. (American Institute of Electrical Engineers), according to the 1907 edition mentioned above.

Owing to the limited space allotted to each item in the table, a rigorously correct presentation of each particular rule cannot be expected. It has, however, been endeavored to present the substance of each set in a convenient form for comparison, in order to educe their various conformities or points of difference.

It will be observed that while there are many points of difference, there are also many points of agreement and there are no differences that appear insuperable to mutual adjustment.

Erection of Transmission Line Towers in Porto Rico.

By W. R. Strickland.

It is believed that a description of the method of erection of steel transmission line towers employed by the Porto Rico Power & Light Company will prove of interest as illustrating the difficulties that must be overcome in such work.

Fig. 1 shows the style and dimensions of the regular tower;

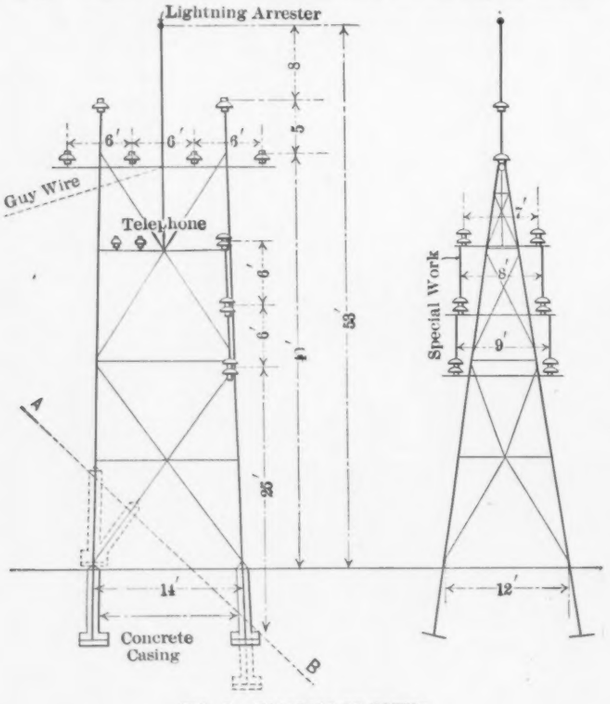


FIG. 1.—DIAGRAM OF TOWER.

it also shows a special arrangement for crossing the La Plata River by a span of 600 ft. at about right angles to the line on each side. These towers were built to carry two three-phase 20,000-volt circuits of No. 4 hard-drawn copper wire, the insulators being triple petticoated and tested to 60,000 volts. A ground wire is placed in the center on the upright pipe for lightning protection, and two telephone wires are carried on insulators mounted within the steel pole structure. They are of structural steel heavily galvanized, and were shipped in bundles, most of which could be handled by four men. There were four similar pieces for one tower, the large cross arm and the pipe for ground wire, being very heavy, were shipped

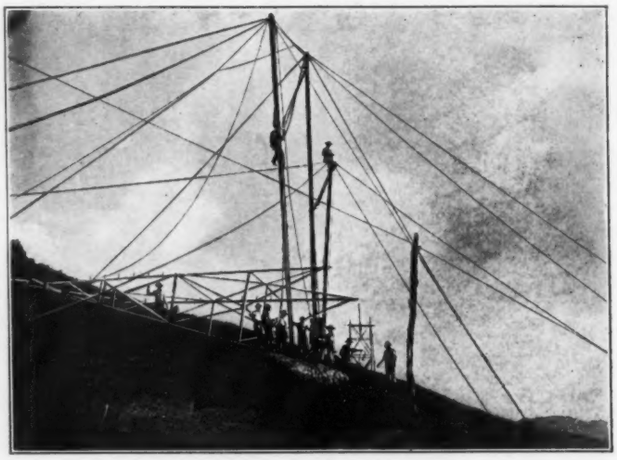


FIG. 2.—PREPARATION FOR ERECTION OF TOWER.

separately. The towers were assembled in the field with bolts and nuts heavily galvanized over the threads. The net weight of each standard tower is 2200 lb.

Several methods of erection were considered, the most popular suggestion being the movable A-frame. This method, as well as others, could not be used for several reasons. The center of gravity of the towers is very high, and the steep slopes upon which they had to be erected would have made it necessary for the A-frame to work at right angles to the line, in which case the tower would have had to be turned after erecting owing to the necessity of assembling it with the cross arm lying flat upon the ground. Some of the hills were as steep as indicated at A B in Fig. 1, so that the towers had to be cut away to fit before erection, and separate concrete anchorages were used for laterals and horizontal braces. There were few level spots such as shown in Fig. 4, where the first tower was erected. The weight of an A-frame would have been too great in one piece, as it had to be carried by hand from tower to tower, because of the broken character of the country. Moreover, the bottom legs of the tower were too flexible for the weight thrown on them sideways during erection in a manner not contemplated in the design. While the lateral braces were large enough for the tension which will come on them after erection by reason of the pull due to wind pressure, they could not carry the compression which would have come on them in resisting the stresses developed by the eccentric loading at the end of the leg during erection.

As a result of these conditions peculiar to the tower and the country, the following method was employed for application by an American general foreman, all of the rest of the labor, with one exception, being Porto Rican.

One gang in charge of a Porto Rican engineer dug the holes, put in the concrete footings, and cut off or lengthened the lower legs to correspond to the slope of the hillside. Another gang assembled the towers with the exception of the lower leg pieces, while another gang erected the small gin-pole shown on the right in Fig. 2. Then came the main erecting gang carrying large gin-poles, blocks, tackle, dead-men, tools, etc. The small gin-pole being in place, the last gang quickly erected the first large gin-pole, which in turn was used to erect the second, as shown clearly in Fig. 2.

The most difficult problem at each tower was the anchoring of the many guy lines needed. For this purpose trees were occasionally used, but in most cases steel dead-men had to be driven in the ground; in some cases the ground was so soft that

two dead-men had to be used. The erecting of the main poles was in charge of a mate from a Porto Rican sailing vessel, as sub-foreman, his principal assistants being six sailors whose carefulness and good judgment were such that only twice did the gin-pole break away.

In Fig. 3 is shown a tower hoisted from the ground and

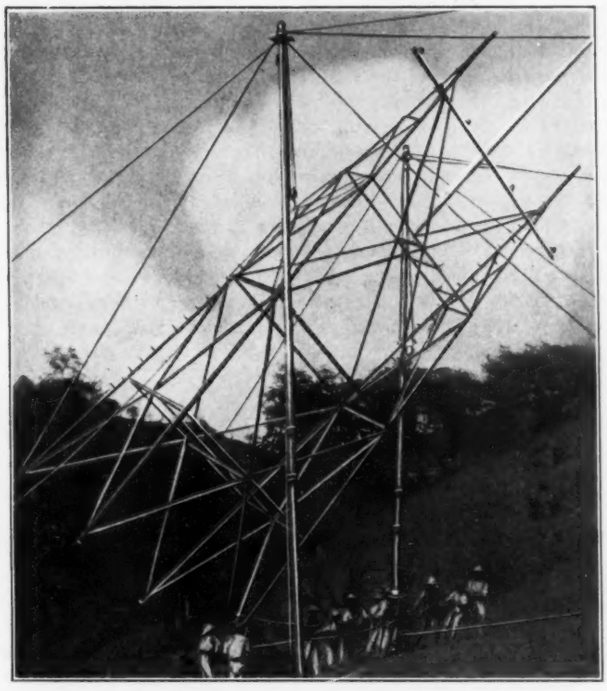


FIG. 3.—TOWER IN RAISED POSITION.

being pushed into position. The lower legs are slipped into the holes and bolted to the tower, after which the tower is lowered onto the concrete footings and left for the last gang, which levels and centers the tower, placing concrete around the legs and the anchor up to about 6 in. above the ground. It will be noted from Fig. 3 that the small gin-pole has been

FIG. 4.—VIEW ALONG TRANSMISSION LINE.

taken down, and at the time indicated it was being erected for the next tower.

At each angle point, the tower was set to bisect the angle in the transmission line, a supporting guy being held by concrete anchorage. Four or five towers were erected per day. After the men had gained a little experience the cost of erection, including all labor and material, sub-delivery of towers and concrete, cement at $3.50 per barrel at the tower, assembling, erecting and concrete footings and casing was brought down to from $25 to $27 per tower. Owing to special work, and some towers in exceptionally bad locations, which required more care and more concrete, and owing to delays caused by right of way fights, the average cost was considerably higher. Each common laborer was paid 75 cents per day, the sub-foreman receiving $2 or $3.

Fig. 4 shows three towers completed, and gives an idea of the character of the country. While the line for about two miles was near a wagon road, for the most part it was erected across country to San Juan, 20 miles distant, deviating from a straight route only where necessary to avoid very high mountains. The distance to the nearest wagon road was from half to a couple of miles, making it necessary, after hauling the material on an average of seven or eight miles on the road, to carry it on sleds by oxen over the hills to its location.

The spacing of the towers averaged about 440 ft. center to center, but in some cases 550-ft. or 600-ft. spans were used, the larger spans, however, occurring only where there were deep gullies or creeks to be crossed. In case of the longer spans the supporting towers were specially strengthened by guying.

Accuracy of Electric Meters.

In the report of the committee on meters before the Chicago convention of the National Electric Light Association it was pointed out that during the past year meters have been, to an especial degree, the object of legislation and that the tendency of the latter is all the time more restrictive. These facts the committee says serve to emphasize the necessity of the utmost care in the measurement of electrical energy and the folly of leaving this matter in the hands of inexperienced men. Any company would stand aghast at a 20 per cent increase in its coal costs and would probably employ high-priced experts to find out the trouble; but many of them fail to realize that a drop of 1 per cent in the accuracy of the customer's meter will affect the profits just as seriously.

In order to insure the accuracy of its meters, every company should maintain standard instruments which are accurate within a small fraction of 1 per cent. There should be a careful system of checking all working instruments with these standards and a thorough system of testing customers' meters. Careful records of meter accuracy, showing the number of meters fast or slow and the amount of these errors, should be kept. One of the members of the committee urged the importance of testing meters in position.

The trend of legislation emphasizes the fact that companies should prepare themselves for meter-regulating ordinances, and the committee recommended that companies assist in the preparation of these regulations which, while safeguarding in every way the interests of the customer, should not be unjustly oppressive on the companies. As preliminary to a general discussion of the subject, a communication from a company in New York State, whre the matter of meter regulation has gone further than anywhere else in the country, was incorporated in the report. In this communication attention was called to the advisability of operating companies inviting reasonable inspection, not only of service meters but of the standards by which they are calibrated. The following points were emphasized in the communication: The sealing of meters by a government official is a great hindrance in the way of maintaining meters accurate. Standards properly checked by official inspectors give a value to these that they ordinarily would not possess in the eyes of the community. If all meters are to be tested, the testing should be performed on the customer's premises. Systematic records of the calibration of all meters should be kept open to a representative of an authorized commission at any time. The results of meters tested on complaint should be forwarded to the commission for its approval and revision, if desired. A reasonable charge should be fixed for testing meters on complaint, and if

all meters are to be tested this should be done at the expense of the government. When tests are made by an inspector on complaint, at least three points should be taken in the load curve, to be agreed upon in advance, the average of which shall be used in determining whether the meter is accurate within the provisions of the law. It was suggested that these points be 10 per cent of the meter rating, one-half load and full load. If some such arrangement is not made in advance, it will often be necessary to condemn meters which are actually measuring the energy used by the customer with reasonable accuracy.

Letters to the Editors.

Economics of Electric Illuminants.

To the Editors of Electrical World:

Sirs:—From the editorial with which you kindly introduced my article on the "Economical Aspect of the Various Electric Illuminants," published in your issue of May 16, and also from conversations recently with several friends, I am led to think that an impression exists that the initial cost of a lamp was not considered and included in the tables and curves of the article. This is not correct as far as the incandescent lamps are concerned; for example, the initial cost of a tungsten lamp is assumed and entered at $2. It is stated in the article to be impossible to subject the initial cost as well as depreciation and interest of the invested capital to general rules. Moreover, they do not materially influence the cost of the kilo-candle-hour since the life of the arc lamp, as a whole, as well as that of the fixtures for incandescent lamps, are so long that the factor corresponding to the cost per kilo-candle-hour of what might be called the "outfit" is infinitessimal as compared with the total cost of the kilo-candle-hour, and can be neglected. While, therefore, the factors mentioned above could have been omitted from the article without impairing its correctness, it was the intention of the writer to treat exhaustively the matter of economy of lamps and, therefore, the influence of the capital invested for outfit was not ignored, even though negligible. It is, therefore, not correct to assume that the article has reference only to an installation fully completed and with all the lamps provided and paid for. The data given apply to all economical considerations imaginable, in order that the estimating engineer may be enabled to pass judgment as to which lamp under examination is to be given the preference.

New York. Alfred A. Wohlauer.

Looping vs. Cutting Lines of Force.

To the Editors of Electrical World:

Sirs:—With reference to Mr. S. Sano's letter in your issue for May 30, it appears to me that under the conditions laid down by him—if such were possible—e.m.f. would not be generated by the ammeter conductors, as he assumes that the conductors lie in slots offering infinite reluctance to the magnetic lines. If, however, to modify Mr. Sano's premises, we assume that the reluctance of the slots is finite, but very great as compared with that of the teeth, we may imagine the lines being dragged by the leading tooth until the reluctance of the path through the tooth becomes greater than that through the slot; they would then cut through the slot, tending to take the low reluctance path through the tooth behind, and in so doing be cut by the conductors, thus generating an e.m.f.

In practice, of course, the process would be continuous and the e.m.f. would be proportional to the number of lines cut by the conductors; it would not be produced by the lines which were not cut by the conductors as assumed by Mr. Sano.

Weehawken, N. J. James Gibbons.

Rocky Mountain Telephone Strike.

To the Editors of Electrical World:

Sirs:—The item published in your paper of May 23, relative to the settlement of the strike of linemen and operators of this company in Montana, is erroneous in the statement of facts in most all particulars, except the one that the strike is settled. However, the only thing that interests us particularly is that a statement was made that the injunction suits were to be dismissed at our instigation. It must be evident to you that an injunction granted by a Federal court takes the matter out of the hands of the party asking for such injunction and places it exclusively within the hands of the court. Any agreement, therefore, with a labor union to dismiss an injunction brought against it by the Federal court would necessarily be in contempt of that court. We have settled the Montana strike on terms that are satisfactory to both sides, but the two injunctions granted by the Federal court necessarily stand and were not involved in the settlement. D. S. Murray,

General Manager Rocky Mountain Bell Telephone Company.

[We regret the errors to which Mr. Murray alludes. The item in which they appeared was compiled from a newspaper report of the settlement of the strike.—Eds.]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Generators, Motors and Transformers.

Rotary Converters.—T. Fraser.—A note stating that the old prejudice against the rotary converter in Great Britain is dying out and that its advantages of high efficiency, great overload capacity and low voltage on the rotary element are being gradually recognized.—*Elec. Jour.*, May.

Lamps and Lighting.

Tungsten Lamps.—An account of two recent and apparently important British patents on the manufacture of tungsten lamps. According to a patent of the British Thomson-Houston Company (General Electric Company of this country), tungsten filaments which ordinarily are very brittle, become sufficiently ductile to permit of their being drawn into finer filaments which can be bent or shaped at will, if they are heated to a temperature just below red heat or below the point at which the metal oxidizes. For this purpose the tungsten filament may be wound on a heater mandrel or shaped between heated metal blocks in the open air, the temperature of the mandrel or of the blocks being such as to raise the temperature of the tungsten to a point just below visible redness. According to a patent of the Allg. Elek. Ges. it is possible to materially increase the specific resistance of tungsten by certain additions. If oxides of yttrium, ytterbium and certain other rare metallic earths having high atomic weights and high affinity for oxygen are added to the filament, the resistance is considerably increased, the vacuum is not impaired and the life of the filament is not decreased. Ytterbium is most suitable; about 20 per cent of ytterbium oxide are mixed with metallic tungsten or tungsten oxide powder and the mixture is made into a paste with a suitable binder. The filaments made from this paste are heated to a high temperature in a reducing atmosphere until the tungsten oxide is reduced, the binder vaporized and the filaments have become hard. When a filament prepared in this way is placed in an evacuated bulb and heated to a very high temperature, the bulb remains quite cold, a proof that gases are not given off by decomposition.—Lond. *Elec. Eng'ing*, May 14.

Metallic Filament Lamps.—H. Pecheux.—The author has determined the "characteristic curves" (showing the relation between volts and amperes) for various incandescent lamps. Fig. 1 gives the same (a) for 20-cp, 125-volt carbon lamps,

(β) for 25-cp, 130-volt tantalum lamps and (γ) for 25-cp, 130-volt tungsten lamps (candle-power meaning hefner candles). The scale of this diagram is as follows: 1 mm of the axle of abscissas represents 0.01 amp; 1 mm of the ordinates 2 volts. Fig. 2 gives the characteristic curves for three tantalum lamps: a for 120-volt lamps, b for 125 volts and βc for 130 volts. The candle-power in hefner candles, as function of the voltage E, is given by the following expressions: $3.98 \times 10^{-14} \times E^{7}$ for 19-cp, 125-volt carbon lamps, $1.54 \times 10^{-7} \times E^{3.9}$ for

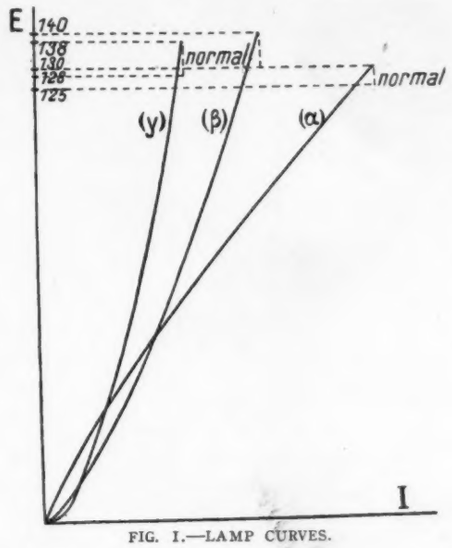


FIG. 1.—LAMP CURVES.

27-cp, 130-volt tantalum lamps, and $1.82 \times 10^{-6} \times E^{3.4}$ for 28-cp, 130-volt tungsten lamps. The constants in these expressions are valid for new lamps. In course of time they change on account of a change of the resistance of the filament.—*La Lum. Elec.*, May 16.

Bremer Arc Lamp.—Two fundamental claims in an important patent by Bremer have been declared invalid by the highest German court. The decision, which is given in full, is based on the lack of novelty in the method covered by the sec-

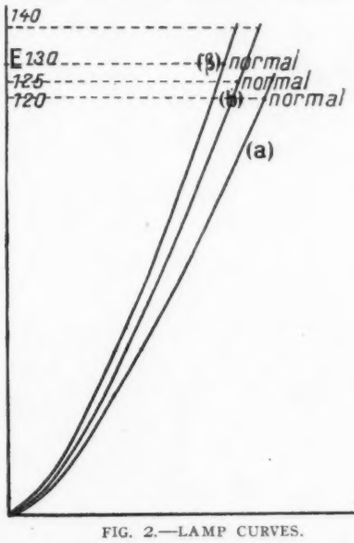


FIG. 2.—LAMP CURVES.

ond claim. The first claim, which has been declared invalid, is general and refers to the regulation of an arc in such a way "that the regulating mechanism is influenced by the position of the arc, which changes with the consumption of the carbons." The second claim refers to the effect of a magnetic field on the resistance of the arc so as to draw out the arc and increase the resistance without changing the distance between the terminals of the carbons.—*Zeit. f. Beleucht.*, April 10.

Metallic-Filament Lamps for Street Lighting.—An account of the results which have been obtained in various British towns with tantalum and tungsten lamps for street lighting. The results are shown to be very satisfactory; but it is strongly recommended to pair the lamps suitably when they are to be run in series. They are, therefore, tested in advance. The average life is mostly given as over 1000 hours, and in several towns most of the lamps are said to have a life of more than 2000 hours. Metallic-filament lamps are increasing in application instead of gas lamps for street lighting, and in some cases they are also replacing arc lamps. In those cities in which the lamps have been in use long enough to get accurate estimates of cost, metallic-filament lamps have been found to be a good deal cheaper than gas.—Lond. *Elec. Eng'ing*, May 14.

Generation and Transmission.

Efficiency of Heating Surfaces.—C. H. WINGFIELD.—A paper read before the (Brit.) Civ. and Mech. Eng. Soc'y. The author was called upon to design boilers for very different draughts. The air pressures varied from 10 in. down to 0.75 in., and there were no data. He started with Rankine's formulas as a basis, the rule-of-thumb methods of the boilermakers being useless. They left varying rate of combustion out of the reckoning. One of the greatest popular fallacies, the author considers, is the belief that the rate at which heat passes from the hot gas to the water in a boiler varies directly as the difference between temperatures. This idea does not take into account the "surface resistance." The nature and exact reason for the existence of this surface resistance are very obscure. Fletcher found that pieces of paper attached to the dry side of a furnace plate did not char. Sir John Durston proved experimentally that 90 per cent of the whole resistance exists on the dry side of the plate. The author is disposed to believe that, while some of the resistance may be due to a film of air, the greater part is an inherent quality of the plate itself. Another "popular fallacy" is that any heat-absorbing surface, such as that of a water-tube, is necessarily more efficient if the flame and gas beat on it transversely than if they move longitudinally. With respect to the heat transference question, the author confirms Rankine's formula: $Q = \frac{(T-t)^2}{a}$ where Q = units of heat transmitted by 1 sq. ft. per hour, T = temperature of the gases, and t = that of the water. The denominator a is an empirical constant. The rate of transmission varies, therefore, as the square of the temperature differences. Blechynden and others have also confirmed this. One curious conclusion to which his experiments led Mr. Blechynden was that copper, after being in use for some time, transmitted less heat than steel, although the latter is comparatively a poor conductor of heat. The inference is that the surface resistance is the cause of this loss of transmissivity and that a film of copper oxide offers more resistance than a film of iron oxide. The paper concludes with an appeal for information as to just why there is such a great increase in the rate of heat transmission with the feed water at steam temperatures.—Lond. *Elec. Times*, April 9.

Calculation of Transmission Lines.—A. BLONDEL.—A mathematical paper illustrated by diagrams in which the author shows that the calculation of a transmission line containing inductance and capacity may be easily carried out by his former graphical method for transmission lines without capacity, some slight modifications only being necessary. Five numerical problems are given, one referring to the determination of the current at the receiving end when the voltage at the transmission end and the constants of the line are given.—*La Lumière Elec.*, May 9.

London.—A long account of the proceedings before a Parliamentary committee concerning three bills on electric energy supply in London.—Lond. *Elec.*, May 15, and *Elec. Eng'ing*, May 14.

Traction.

Electric Traction.—P. DAWSON.—A continuation of his very long illustrated serial. The author now begins to discuss single-phase traction and to summarize the development of the single-phase motor from an historical point of view.—Lond *Elec.*, May 8.

Brake.—H. D. James.—An account of a series of experiments in which the author investigated the best material to use for the friction surfaces in brakes. The best combination proved to be a cast-iron shoe bearing on a cast-iron wheel. Under heavy pressure the coefficient of friction in his experiments was 0.3 and the wear on the brake wheel about one-sixteenth of the wear on the shoe. The author shows that it is possible to select the point of suspension for the brake shoe in such a way that the retarding force acts directly along the brake beam and in line with it. The pressure of the shoe against the wheel is then uniformly distributed over the brake wheel and the shoe is free to turn and find a true seat on the wheel. Long life of both the shoe and the wheel are thus insured. The clearance between the wheel and shoes may be very small, which assists in reducing the size of the magnet. The pressure between the wheel and shoes is applied by means of a helical spring located over the wheel and connecting the brake beams. In operating, the spring lifts the plunger of the magnet upward away from the stationary core. In releasing the brake, the electro-magnet draws the plunger down, the spring being stretched just enough to clean the shoes from the sheets. Tests have shown that the minimum amount of wear is obtained when the brake shoes are designed for the maximum pressure which can be used without cutting. This means that a large amount of braking force is obtained with a comparatively small wheel, but a large magnet is required to exert the pressure. By making the magnets of steel and ribbing the outside surface, very much better results can be obtained than with cast-iron magnets having a smooth surface. The magnets are entirely enclosed and all of the heat must be radiated from the external surface.—*Elec. Jour.*, May.

Installations, Systems and Appliances.

Danger of a Poor Ground Connection on the Secondary of a Transformer.—R. P. Jackson.—While it is common practice to ground the secondaries of service transformers as a protection against danger incident to break-down between the high- and low-tension windings, it may often occur that if this connection is not carefully made and is not of low resistance, it will introduce an element of danger. The arrangement of circuits and ground connections in Fig. 3 shows how actual dan-

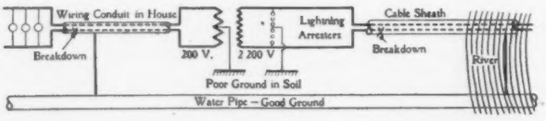


FIG. 3.—ARRANGEMENT OF CIRCUITS AND GROUND CONNECTIONS.

ger to life and also a fire resulted from a poor ground, when with either a good one or none at all there would have been no trouble. In this particular case the neutral of the lighting circuit and the middle point of a two-pole lightning arrester were grounded at the same pole to two plates which had been buried in the same hole in the earth. The resistance between these two ground plates was very low, but the resistance between them and the good ground of the water-pipe system and the river was comparatively high. The 2200-volt mains were carried across the river in metallic-sheathed cable and the house wiring was placed in metal conduit connected to the water system. When by accident the cable in the river became grounded on one side of the 2200-volt circuit, a potential of 2200 volts was placed on one side of the lightning arrester. This arrester then broke down and connected the ungrounded side of the 2200-volt circuit to the lightning-arrester ground-plate, which practically meant that both ground plates were raised to a potential of nearly 2200 volts above that of the river and the water system. The resistance between the plates and the water-pipe system and river was high enough to prevent the flow of sufficient current to materially lower the potential delivered to the terminals of the transformer. The result, therefore, was that the two ground plates and the lightning circuit were at a potential of nearly 2200 volts above the water pipes and also of the conduits of the house wiring. This was the cause of the breakdown which started a persistent arc that resulted in a fire. If the earth connection of the 2200-volt circuit had been much better, or if there had been none at all, there would have been no trouble. If, however, in conjunction with this trouble there had been a breakdown between the high- and low-tension windings of the transformer, the only absolute safety would have been in a very low resistance and effective earth connections for the secondary circuit; no earth connection or ground whatever would have meant both a life and fire danger.—*Elec. Jour.*, May.

Direct-Current Three-Wire System with Alternating-Current Connections.—W. Fuhrmann.—In order to connect consumers at a distance with a small three-wire direct-current network the author recommends the use of a three-conductor direct-current generator, for instance, of the well-known design of Dobrowolski, in which the neutral conductor is connected to the central point of an inductance coil connected between two slip-rings. The alternating-current connections leading to a consumer at a distance are made to the two slip-rings, through the intermediary of a transformer. It is also possible to use three slip-rings with three inductance coils, the middle one being connected to the neutral wire of the direct-current three-wire system. In this case there is transmitted to the distant consumers, through the intermediary of a three-phase transformer, energy which is useful for driving of motors.—*Elek. u. Masch Bet.*, May 5.

Rectifier Station for Charging Storage Batteries.—R. Venus.—For charging the storage batteries in the telephone exchange of Rixdorf, in Germany, from a 3 x 220-volt, three-phase network, rectifier relays of the design of Koch (described in the Digest Feb. 15, 1908, page 352) are used. The German telegraph department has been using this type of rectifier with good success for changing single-phase current into direct current. In the present installation the rectifier is used for the first time with three-phase currents. Two relays are inserted in the circuit of each phase so that both half-waves of the alternating current of each phase are utilized. The arrangement is described in detail and illustrated. The results obtained are so good that it is intended to use this type of rectifier in the new Essen telegraph station.—*Elek. Zeit.*, May 14.

Lighting of Exhibition.—An illustrated description of the electrical installation of the Franco-British exhibition, now being held in London. There are about 100,000 lamps installed in the various buildings, the "fairyland" system being generally employed. In this system use is made of a special twin rubber-covered cable to which special lampholders are fixed about every 12 in. These lampholders, which are of a special water-tight pattern, are connected without cutting the conductors, so that a bad contact affects only the lampholder in question. The back of the lampholder, where the connections to the terminals are made, is sealed with a special compound so that all moisture is absolutely excluded. The lamps may be fixed vertically or in any position. No metallic parts are exposed to the atmosphere.—Lond. *Elec.*, May 15, 22.

Wires, Wiring and Conduits.

High-Tension Insulators.—C. J. Greene.—The conclusion of his article on high-tension insulators for overhead transmission lines, the first part of which was recently abstracted in the Digest. The author gives tables of the standard makes of insulators—both straight-line and shackle insulators—made in different countries. These tables give quite complete information on price, dimensions, test voltage, arcing distance, factor of safety, creeping surface, etc. With respect to factor of safety, the tables show that at high voltages in some cases it is very small, even when measured with rain falling at 45 deg., and there is no doubt but that this is due almost entirely to the difficulties in making large insulators. The design of very large insulators for the high voltages now in use seems to be governed very largely by the difficulties of manufacture, theoretical considerations of electrical and mechanical strength having to become subservient to the capabilities of porcelain. The steady rise of the factor of safety as voltages decrease is clearly indicated. As to the advisability of con-

necting the insulator pins to ground, there is considerable difference of opinion, but it should not be overlooked that by earthing the pins the safety of the insulator is materially decreased.—Lond. *Elec. Rev.*, May 1.

Electrophysics and Magnetism.

Resonance Spectra of Sodium Vapor.—R. W. WOOD.—An account of an experimental method of analysis of the sodium spectrum which, the author thinks, may become a means of determining the exact nature of the constitution of the sodium molecule on the basis of the electronic theory. If sodium vapor is illuminated with a powerful beam of white light, it becomes strongly fluorescent, emitting a spectrum which the author believes to be the exact counterpart of the absorption spectrum. If, however, monochromatic light is thrown into the vapor instead of white light, a series of bright lines is obtained spaced at very nearly equal intervals along a normal spectrum, and separated by a distance equal to about 37 Angström units. Various series of lines with varying distribution of intensity can be brought out by changing the wave-length of the exciting light. In every case, light of the same wave-length as that of the exciting light is emitted by the vapor, and, in addition, a large number of other frequencies, which bear a definite relation to each other. These spectra are called by the author resonance spectra, since they are excited by the resonance of one or more of the electrons of the system when monochromatic radiation plays upon it. The author reports the results of an extended investigation of the spectra excited by the radiations from cadmium, zinc, lithium, barium, magnesium, lead, bismuth, silver and copper arcs.—*Phil. Mag.*, May.

Short-Spark Phenomena.—W. DUDDELL.—An abstract of a (Brit.) Phy. Soc'y paper which deals with two effects which the author has observed in connection with some measurements of the current in the secondary circuit of an induction coil. The apparatus in use consisted of a "12-in." induction coil which was supplied with energy from the 200-volt direct-current mains. A resistor of large resistance was placed in series with the primary of the coil to limit the current, and the current was interrupted by means of a mercury-jet device. The secondary circuit contained a galvanometer to measure the mean current, and a thermo-ammeter to measure the effective current. When there was no spark-gap in the secondary circuit, and the coil was in action, the mean current, as read by the galvanometer, was zero and the effective current about 3.8 milliamperes. When a microscopic spark-gap, say, between two aluminum points, was introduced into the secondary circuit two curious effects took place. Firstly, the effective current enormously increased in value; and, secondly, a very large deflection was produced on the galvanometer in the direction corresponding to that due to making the primary circuit. The introduction of a spark-gap 1/10 mm long caused the effective current to rise to 38.5 milliamperes, and this continued to increase with increasing length of spark-gap until it reached a maximum with a gap of about 1.4 mm. The author thinks that this effect is due to very high-frequency oscillations set up in the wires connected to the secondary circuit of the coil when a spark-gap is introduced. He has observed the effect with brass, iron, zinc and aluminum electrodes; the latter metal is the best to use. The large deflection in the negative direction observed on the galvanometer was investigated by recording the wave forms of the potential difference and the current by means of an oscillograph.—Lond. *Eng'ing*, May 8.

Electrons.—E. A. PARTRIDGE.—A Frank. Inst. paper discussing the fundamental principles of the electron theory and its experimental foundations. The author finally refers to Planck's thermodynamic theory of radiation, and his mathematical deduction of the mass of the hydrogen atom and also of the charge called the elementary quantity of electricity. "The determination by Planck of the mass of a hydrogen atom and the charge constituting an electron is, to my mind, one of the most remarkable intellectual results ever achieved."—*Jour. Frank. Inst.*, May.

A New Radioactive Element.—B. B. BOLTWOOD.—Uranium minerals contain a new radioactive element to which the name ionium has been given by the author. Its chemical behavior is similar to that of thorium.—*Am. Jour. of Sci.*, May.

Units, Measurements and Instruments.

Determining the Capacity of a Submarine Cable.—A. TOBLER.—An illustrated description of the method of Devaux-Charbonnet for determining the capacity of a submarine cable. The principle is indicated in Fig. 4. If K_2 is pressed down and then K_1 (the switch U being connected to 2) the battery E charges the condenser C and the cable X in series. If V is the potential of the condenser plates connected to K_2 and U, the equation $C\ (E-V) = XV$ is applicable. The short-circuit switch T of the galvanometer G is then opened and K_2 is released, whereby the condenser C receives the full charge $Q_1 = CV$, the galvanometer needle being deflected by the angle δ_1. One need only determine the constant, namely the charge which the

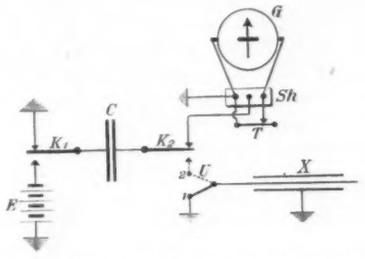


FIG. 4.—DETERMINING CAPACITY OF SUBMARINE CABLES.

voltage E impresses on the condenser C. After connecting X to earth by means of U and releasing K_1, one presses K_1 down again for five seconds and discharges C through G, which gives $Q_2 = CE$, the deflection of the galvanometer needle being δ_2. From these three equations is obtained directly $X = \frac{C\ (Q_2 - Q_1)}{Q_1} = \frac{C\ (\delta_2 - \delta_1)}{\delta_1}$ In order to get convenient values of δ_1 and δ_2 it is necessary in certain cases to shunt the galvanometer. The instruments used in practice are described and some numerical examples are given.—*Jour. Télégraphique*, April 25.

Condensers.—G. F. MANSBRIDGE.—An illustrated paper read before the (Brit.) Inst. Elec. Eng. on the manufacture of electrical condensers for telegraphy and telephony. The aggregate output of the condensers in Europe and America during 1907 was 5 farads. Manufacture on a large scale and with the aid of labor-saving appliances has resulted in reducing the price to about one-tenth of the former value. The author describes in detail the method employed in condenser manufacture. In the author's process, used by the British Post-Office for manufacturing condensers for telegraph and telephone work, metallic tin, precipitated chemically or electrically from a solution of tin in nitrohydrochloric acid, is mixed with an adhesive substance and pasted on the paper; after drying, the metallized surface is burnished and forms a coherent thin metallic film. The paper is then subjected to a high voltage, which fuses away the film of metal surrounding the weak spots in the dielectric. The drying, impregnation and compression of the rolled sheets are dealt with at length, particular stress being laid on the fact that too much mechanical pressure, although it increases the electrostatic capacity, considerably decreases the insulation resistance, and also the resistance to breakdown. The author recommends the use of good paraffin in preference to any other wax for condenser work. In an appendix to the paper are given the Post Office and National Telephone Company's specifications for condensers for telegraphic and telephonic use.—Lond. *Elec. Eng'ing*, May 14.

Condensers.—B. V. HILL.—An account of an experimental investigation of the variation of apparent capacity of a condenser with the time of discharge and the variation of capacity with frequency in alternating-current measurements. The results are given in diagrams and tables. It is shown by comparing the discharge curves of the several condensers tested with their alternating-current capacities, that the latter cannot be inferred from the former. Taking a certain commercial tele-

phone condenser, as an example, it is shown that up to 0.01 second the capacity is only about 37 per cent of that obtained when the condenser is allowed to discharge for the whole quarter period of the galvanometer. With an alternating current, however, in which the period of charge—that is, the quarter-period of the complete oscillation—was only 0.00008 seconds, the capacity was still 80 per cent of that obtained by the ballistic method and the complete quarter-period of the galvanometer.—*Phys. Rev.*, May.

Speed and Frequency Meters.—K. Seidl.—An illustrated article on methods of measuring the speed of revolving machines from a distance. There are two different classes of instruments. In the first class a small dynamo is connected to the revolving machine so as to rotate at the same speed. If this dynamo is excited with constant current its e.m.f. is proportional to speed. The indicating instrument is therefore a simple voltmeter calibrated in revolutions per minute. In the second class of instruments a small alternator is connected to the revolving machine so as to generate alternating current of a frequency which is proportional to the speed. The indicating instrument is a frequency meter; the instruments of Frahm and of Hartmann-Kemp using a series of steel tongues tuned to different frequencies are described. Only the one tongue which is tuned to the frequency of the alternating current is set into vibration. (The construction of this instrument has been described in detail in the Digest.) The range of frequencies within which these instruments are preferably used is from 30 to 130 periods per second. The steel tongue makes a full vibration for each half wave (for each alternation) of the alternating current. In order to extend the range upward to 260 periods per second the following means is often useful: To the alternating magnetic field, produced by the alternating current, a second permanent magnetic field is added which just annihilates one-half of the alternating field so that only every second half-wave produces a vibration.—*Glückauf*, May 9.

High-Frequency Measuring Instruments.—J. Bethenod.—Indicating instruments for high-frequency circuits (for instance, hot-wire ammeters, bolometers, thermoelectric elements, etc.) always have a considerable ohmic resistance which has a damping effect on the instrument. It has been thought that the damping effect could be avoided by not inserting the instrument directly in circuit, but exciting it by induction. The present author shows, however, that this is not the case, and that with respect to the damping effect the inductive connection of the instrument is rather disadvantageous. This arrangement is useful only with very sensitive instruments and with them it has the advantage that the range of the instrument can be easily extended by varying the mutual inductance between the primary and secondary of the transformer.—*La Lumière Elec.*, May 2.

Water Recorder.—An illustrated description of a recording instrument of English make which is of general application for the measurement of water when flowing freely over weirs or through notches, but which is especially suitable for the measurement of boiler-feed water and the discharge from air-pumps. It is stated that this instrument is now used considerably in English central stations.—Lond. *Elec.*, May 8.

Working Standards of Light.—C. O. Bond.—A Franklin Inst. paper describing and discussing the following working standards of light and their use in gas photometry: British candles, the Edgerton standard, the Hefner lamp, the Elliott lamp and the pentane lamp. The author considers the latter to be best adapted for gas photometry of the accurate kind.—*Jour. Frank. Inst.*, March.

Lack of Uniformity of Revolution.—F. Loppe.—A review of the various methods which have been devised to determine the lack of uniformity of speed of revolving machinery during one revolution.—*L'Ind. Elec.*, April 25.

Telegraphy, Telephony and Signals.

Large Telephone Cables.—An illustrated description of two large telephone cables of British make. The first is an 800-pair (1600-wire) cable made of such a size that it can be drawn into a standard 3-in. pipe. The conductors weigh 10 lb. per mile. Each conductor is insulated by a single layer of manila paper, applied spirally; the longitudinal method of wrapping with a whipping of thread is employed only for wires weighing not less than 40 lb. per mile. The use of a single layer of paper on each wire, instead of the double layer formerly used, is not only cheaper, but results in a lower electrostatic capacity. The second cable described is a composite telegraph and telephone cable, considerable qualities of which are used by the British Post Office for underground work. The cable contains 15 pairs of 150-lb. twin conductors, seven quadruple pairs or "quads" of eight conductors, each weighing 100 lb. per mile, six pairs of 100-lb. conductors, 22 single "screened" conductors weighing 200 lb. per mile for telegraph purposes, and 42 single screened 70-lb conductors, 162 wires in all.—Lond. *Elec. Eng'ing*, May 7.

Telegraph Cables.—E. F. Petritsch.—The conclusion of his paper on oscillographic tests of telegraph cables with respect to mutual induction. It is shown that mutual induction between conductors in a cable of older construction is very noticeable and it is probable that the use of such cables in extended telegraph lines may lead to trouble. On the other hand, the investigation of the author shows that the new cables of the Austrian Telegraph Department (in which tinfoil is bound around the insulated cable conductors) should prove successful, at least to a certain extent. With all arrangements of the experiments the induction phenomena observed in such cables were so insignificant that they cannot lead to any troubles in telegraph transmission.—*Elek. u. Masch.* (Vienna), May 17.

Automatic Telegraphy.—P. B. Delany.—A Franklin Inst. paper describing the "electromagnetic" automatic telegraph system (the "telepost").—*Jour. Franklin Inst.*, March.

Telegraphy.—Henry.—With reference to the Bogni modification of the Morse system, the author discusses possible improvements in the telegraph system of Italy and France.—*L'Ind. Elec.*, April 25.

Automatic Telephone.—A. B. Smith.—Continuation of his long illustrated serial giving a historical sketch of the development of the automatic telephone.—*Am. Tel. Jour.*, April 18 and May 16.

Vienna.—Continuations and conclusion of the fully illustrated detailed description of the new telephone station at Vienna.—*Elek. u. Masch.*, April 5, 12, 26 and May 10.

Electric Signals.—K. Perlewitz.—An illustrated article on numerous electric devices for giving fire alarm signals or other signals (instead of the usual whistle) in factories and workshops. All these devices are based on the production of oscillations of a metallic membrane giving a sound like a trumpet. Such devices are also used on automobiles.—*Elek. Zeit.*, April 30.

Miscellaneous.

Consulting Engineers.—An editorial discussion of the question whether consulting engineers are necessary. Reference is made to the increasing tendency in England of prospective purchasers approaching manufacturers directly. This practice almost always results in asking for tenders without a sufficiently exact specification. To draw up an accurate specification, the consulting engineer is absolutely necessary.—Lond. *Elec.*, May 8. Some letters on the subject appeared in Lond. *Elec.*, May 15.

Sweden.—Statistical tables on imports and exports of electrical and other materials into and from Sweden.—Lond. *Elec. Rev.*, May 8.

Standardized Notation.—The report of the committee of the German Assoc. of Elec. Eng. proposing a uniform method of notation and diagrammatic representation of the terminals of machines, starters, regulators and transformers with supplementary explanatory notes by F. Natalis.—*Elek. Zeit.*, April 30 and May 7.

Electrical Industry in Austria.—E. Honigmann.—A review of the present condition of the electrical industry in Austria and Hungary with tables and special reference to home consumption and export.—*Elek. und Mash.*, April 26.

Lord Kelvin.—S. P. THOMPSON.—A long account of his first Kelvin lecture on the "Life and Work of Lord Kelvin." The lecture contains much of a personal nature which is of great interest.—Lond. *Elec.*, May 8.

BOOK REVIEWS.

BEITRÄGE ZUM KOMMUTIERUNGSPROBLEM. By Karl Waldmann. Berlin: Gustav Schade. 67 pages; 54 illustrations.

The author investigates the phenomena during commutation in direct-current machines with and without commutating poles and in alternating-current series motors. The various factors affecting the commutation and the sparking limits in direct-current machines are treated in a convincing manner, but the discussion of the commutation in alternating-current motors is far from complete or satisfactory. The book is valuable in reporting the results of series of careful tests made upon direct-current machines, but it seems to contain nothing that is essentially new.

RAILROAD MEN'S CATECHISM. By Angus Sinclair. New York: Angus Sinclair Publishing Company. 200 pages; illustrated. Price, $1.

This little book supplements Sinclair's "Locomotive Engine Running and Management," and is intended to appeal to all railroad men "from the president to the newest brakeman." The questions are stated to be a series employed by a leading railroad system for the examination of engineers and firemen, to which have been added a score based upon the standard code of the American Railway Association. The book lacks the crude character of the usual handbook for engineers, both the questions and answers denoting that it is intended for men of some intelligence.

DIE UNTERSUCHUNG ELEKTRISCHER SYSTEME. Auf Grundlage der Superpositionspringipien. By Herbert Hausrath. Berlin: Julius Springer. 126 pages, 19 illustrations. Price, 3 marks.

A theoretical investigation of electric conducting systems including networks of conducting mains and cables carrying both direct and alternating currents. The treatise is conducted from a mathematical and physical rather than from an engineering standpoint. The final chapter deals, however, with the application of the theory to the measurement of the insulation of electric distributing systems under conditions of full operation. The book is of interest to advanced students of mathematics and physics applied to electrical engineering.

WHITTAKER'S ARITHMETIC OF ELECTRICAL ENGINEERING. London: Whittaker & Company. 159 pages; illustrated. Price, 50 cents.

These 159 pages contain examples in current electricity, in electrochemistry, magnetization of iron, the construction and operation of generators and motors, all of which the student will find helpful in realizing not only the electrical phenomena, but likewise the magnitude of the quantities involved. Well-chosen examples go a good way in removing difficulties and giving clear ideas in every branch of physics. Typical examples are here worked out by way of illustrating principles and also by way of suggesting how practical problems of the laboratory and central station may be successfully attacked. There are 300 examples in the collection which junior students of electrical engineering will find very useful.

ELEKTRISCHE TRAKTION. By G. Sattler. Hannover: Max Jaenecke. 158 pages; 123 illustrations. Price, 4.2 marks.

The characteristics of motors, the energy and power required for traction, the design of the overhead work, track circuits, and third-rail details, together with the selection of protecting and controlling devices, are fully discussed in this little volume. Although there is almost no descriptive matter relating to rolling stock or manufacturers' products, yet the method of treatment is largely descriptive. Theory has by no means been neglected, but the author has explained the theory by applying it to a practical example in each case. Not much of the material is new; in fact, some of the later developments in single-phase and direct-current motors have not been mentioned. However, the book is well filled with useful hints as to the solution of electric railway problems.

STROMVERTEILUNGSSYSTEME UND BERECHNUNG ELEKTRISCHER LEITUNGEN. By Phil. Hafner. Hannover: Dr. Max Janecke. 324 pages, 276 illustrations. Price, 8.60 marks.

This is an excellent practical text-book on the subject of the fall of pressure in conductors and conducting networks. It is written by an engineer for engineers and engineering students. It is abundantly illustrated by numerical examples representing fairly practical conditions. There are five chapters in the book. The first deals with current distribution in two-wire networks. The second considers the design of conductors in regard to cross-section. The third deals with feeders and feeding points. The fourth treats of multiple-wire systems. The fifth is devoted to alternating-current conductors and networks. The work will be of interest to all students of electric distribution from an engineering standpoint.

GRUNDZUGE DER BELEUCHTUNGSTECHNIK. By L. Bloch. Berlin: Julius Springer. 157 pages; 41 illustrations. Price, 4 marks.

This little volume is the best that we have yet seen in any language upon the particular topic with which it deals—the technology of lighting from the quantitative engineering point of view. We have many books on lamps and light sources, and also many on photometry, but the intermediate territory of room, hall and street illumination has very few books devoted to it. A notable exception is the work of which Messrs. Cravath and Lansingh are the authors.

The book is divided into six sections, dealing, respectively, with the elements of lighting technology, the measurement and computation of luminous intensity, analysis of illumination, the computation of illumination, the measurement of illumination, and indirect illumination. A copious appendix gives numerical tables for different types of polar curves. The book contains much that is of interest to the illuminating engineer.

SOMMEIL ELECTRIQUE, EPILEPSIE ELECTRIQUE ET ELECTROCUTION. By Dr. Louise G. Robinovitch. Nantes: A. Dugas & Cie. 98 pages; 27 illustrations.

The chief value of this treatise lies in the point concerning which it differs most prominently from many of the books on the same general subject, namely, the thoroughly scientific methods used by the author in obtaining the facts upon which to base her conclusions. In fact, the book may be considered as a discussion in detail of graphical records of electrical and physiological phenomena obtained under well-defined and controllable conditions. The experiments described include applications ranging from those producing quiet sleep to electrocution. The cardiac and respiratory tracings, considered in connection with the records from the electrical instruments, furnish the substantial foundation upon which the author has built a systematic treatment of the relation between electricity and life.

DIE WISSENSCHAFTLICHEN GRUNDLAGEN DER ELEKTROTECHNIK. By Dr. Gustave Benischke. Berlin: Julius Springer. 580 pages; 489 illustrations.

This is the second and enlarged edition of a text-book which is intermediate in character between a text-book on physics in electromagnetism and a text-book on electrical engineering. It may be described as a text-book on applied electromagnetic physics. The book is abundantly illustrated and is well adapted to the use of students of electrical engineering. The treatment of electrical measuring apparatus is particularly full and clear. There are many mathematical formulas scattered through the pages, but they contain, for the most part, only elementary algebra. The book will be of special interest to students of electrical engineering acquainted with the German language. Besides having an excellent index and table of contents, the

book has the rare merit among German technical volumes of being issued with cut pages.

Erklärung der Gravitation, der Molekularkräfte, der Warme, des Lichtes, der Magnetischen und Elektrischen Erscheinungen. By Johann Sahulka. Leipzig: Carl Fromme. 175 pages; 22 illustrations. Price, 5 marks.

In this little book Dr. Sahulka attempts to give a clear explanation of the relation between electric and magnetic phenomena, heat, light, adhesion, cohesion, and gravitational action. It would probably be expected that an author who assigned to himself the above task would make free use of mathematics, both for proving the relations being discussed and for expressing the physical relations in the most condensed form. However, Dr. Sahulka has not found it necessary to rely upon mathematics, and has been able to discuss the whole subject in simple language readily understood by any one familiar with the fundamental laws of physics. Many of the statements made are given without proof, and in some respects the arguments are not convincing, but, on the whole, the treatment is good, and the book contains much entertaining reading matter.

Autogenous Welding of Metals. By L. L. Bernier. New York: The Boiler Maker. 45 pages, 32 illustrations. Price, $1.

This work is translated from reports of the National School of Arts and Trades of France, and describes the application of autogenous welding to the manufacture of tanks, boilers, piping, etc., together with its application to the manufacture of steel, brass, bars, plates, etc. The flame from the oxyacetylene blowpipe is stated to have a temperature of 6000 deg. Fahr. The metals to be welded are brought to the melting point and the hydrogen and carbon oxide generated in the flame form a reducing atmosphere which protects the melted metal so that oxidation does not take place. The ease with which oxygen and acetylene can now be made, by the addition of water to epurite for the one, and to calcium carbide for the other, has given the art of autogenous welding quite an impetus. The different welding methods are described and compared. The book lacks specific instructions on how to perform the welding operations and inasmuch as the oxyacetylene flame can be used for repairing and cutting metals, such information would be of value.

Theorie der Elektrizität. Edited by Dr. M. Abraham. Vol. I, "Einführung in die Maxwellsche Theorie der Elektrizität," by Dr. A. Föppl. Third edition, revised. 460 pages, 11 illustrations. Leipzig: B. G. Teubner. Price, 12 marks.

This first volume of a series on the "Theory of Electricity" was originally published in 1894 as a separate book with the title "Introduction to Maxwell's Theory of Electricity." Dr. Föppl, who since then has become professor of mechanics at the Technical College, in Munich, and has written the very excellent book on "Mechanics" (4 vols.), asked Dr. Abraham, as stated in the preface, to re-edit the work for the series of which he is general editor. The general appearance and character of the original book is preserved, additions being made only in order to form a connection with following volumes on the "Theory of Electromagnetic Radiation" and on the "Theory of the Elektron." The work, of course, is highly theoretical and will be appreciated only if thoroughly and exhaustively studied by an engineer of excellent mathematical training.

The first part is a special section or introduction to Hamilton's quaternions and to vector quantities. The definitions are rather brief and precise and require a certain amount of reflection and deliberation in order to be thoroughly grasped and digested. It is, however, necessary to acquire and to master this first section in order to be able to study and to understand the matter following. It is of special interest to find the author emphasizing the fact that the conception of the ether as a substance is only hypothetical; that the properties of the ether are entirely different from the properties of matter, and that the chemistry of the ether has proved so far only a word without a meaning.

Electrical Equipment of the Cargo Fleet Iron Company's Works.

The use of electric motors is becoming more and more general in industrial operations, but nowhere are they conquering ground more rapidly than in the iron and steel industries. The electric motor is peculiarly adapted for use in shops where the general conditions are such as those to be met with in iron and steel works, these conditions being the all-pervading presence of coal and other dust, work of a rough and heavy nature and unskilled labor.

One of the best examples of the large part played by elec-

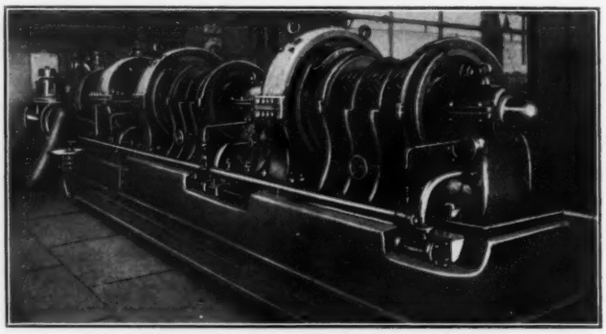


FIG. 1.—DIRECT-CURRENT STEAM TURBO-GENERATOR.

tricity in modern iron and steel manufacture is that afforded by the combined iron and steel works of the Cargo Fleet Iron Company at Cargo Fleet, Middlesborough, England. For several years this company had been employed in the manufacture of pig iron only, until 1905, when a most complete remodeling of the old plant and installation of the new plant was effected in order to enable the firm to convert the whole of its output of pig iron into structural steel. This transformation was most satisfactorily accomplished, and several hundred tons of steel are now being made every week, electricity playing a very

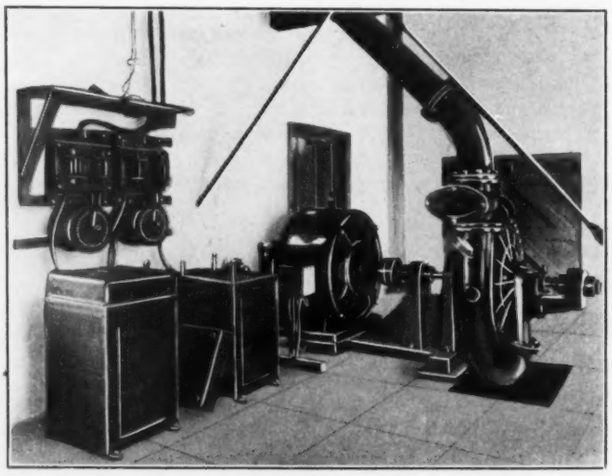


FIG. 2.—MOTOR-DRIVEN CENTRIFUGAL PUMP.

large part in its production. Blast furnace gas, steam, hydraulic, coke-oven and producer gas power are also largely used.

The whole equipment of the works is of the most up to date and complete nature, advantage being taken of the latest improvements in this class of machinery existing in the principal steel manufacturing countries, notably in Germany and America, the steel and iron making plant having been supplied principally by these two countries. The combination of blast furnace and steel plant on one site is probably the first in Great Britain, and has so far proved to be entirely satisfactory.

The works lie right in the heart of a big industrial district, providing a large market right at its doors for the company's products. The company is also very advantageously situated as

regards transportation facilities, the works being in direct connection with the North Eastern Railway. In addition also to the splendid railway facilities possessed by the company, it has an extensive frontage on the mouth of the Tees and at present has a wharf some 300 ft. long, at which the products can be loaded into deep-sea craft for transportation to all parts of the world.

Supplies of the principal raw materials are obtained from within a radius of 20 miles, iron ore and limestone being obtained from property owned and worked by the company. The iron-stone mines are at Liverton, and the limestone quarry is at Mickleton. The supply of iron ore, it is estimated, will last for some 90 years at the present rate of consumption; that is, 7000 tons per week.

The electrical equipment of the works, which is exceedingly comprehensive, includes generating plant, of an aggregate rating of 3300 kw and a large number of motors, aggregating over 4000 hp, the large majority of which were supplied by the British Westinghouse Company.

The generating station contains a variety of prime movers, these consisting of one vertical compound steam engine, one British Westinghouse and one Richardson Westgarth steam turbine, two Premier gas engines operating on coke-oven gas, and two gas engines using blast-furnace gas. The generators consist respectively of one 350-kw, two 750 kw, two 300-kw and two 375-kw, 220-volt direct-current machines. The power house is spanned by a 40-ton traveling Broadbents crane fitted with four Westinghouse series-wound motors.

Coal is brought into the works on railway trucks, drawn by an electric haulage gear driven by a 100-hp motor up an incline onto a gantry running along the back of the furnaces, from which trucks can run on inclines to all parts of the works. The coal trucks pass from the top of this gantry to the screening and washing plants, and from the latter to the disintegrators. From the disintegrators the powdered coal is conveyed to the coke-oven coal stores by a Robin belt conveyor. These coal stores are situated in the center of two rows of Kopper coke-

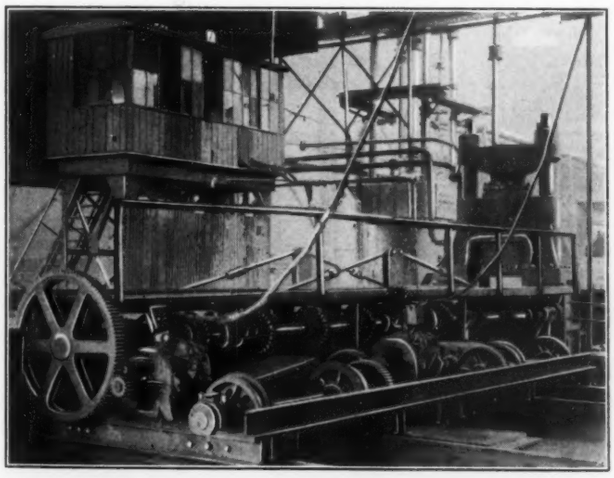


FIG. 3.—SHEAR TRANSFER TABLE OPERATED BY RAILWAY TYPE MOTORS.

ovens, each row containing 50 ovens. Below the coal stores is a space for receiving a Baroper coal-dust compressor, into which a certain quantity of powdered coal is run from the bins above and compressed into a block the same size as the inside of a coke oven. The block of compressed coal-dust is next carried along the front of the ovens on a pair of rails and pushed into one of the ovens by a charging apparatus running on the same pair of rails. On receiving the coal, the doors of the oven are put on and sealed up with fire-clay preparatory to the burning process. The washing, disintegrating, conveying, compressing and charging equipments are worked electrically, the coal washing plant using two motors, one of 140 hp and another of 10 hp, the washing water pump being driven by one of 80 hp. The disintegrator is operated by a 50-hp and the belt conveyor by a 25-hp motor. Each compressor box, of which there are three, is driven by a 35-hp railway-type motor, the two charging boxes being also operated by motors of the same rating.

The coal remains in the Kopper ovens for some 30 hours or more, and is there burned to coke by its own gas. This method is a great advance on the old method of coke making in beehive ovens as carried on in Great Britain until a few years ago, which has now been almost entirely superseded on the Continent, but which is still largely used in Great Britain. The system at Cargo Fleet is by means of air-tight ovens or retorts which yield a far greater output of coke than the old beehive

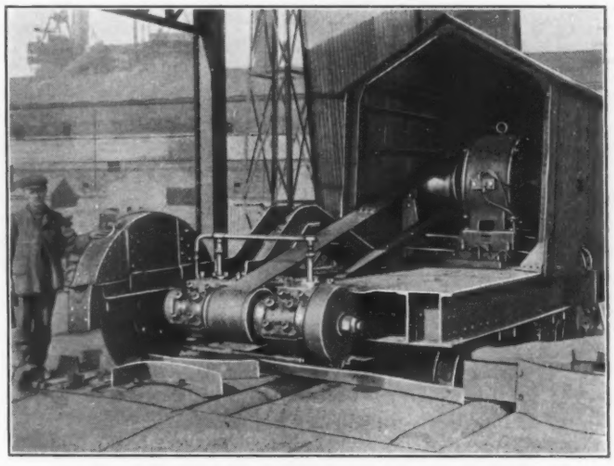


FIG. 4.—HOT SAW DRIVEN BY SHUNT-WOUND MOTOR.

type, and in addition enable many valuable chemical by-products and the gas produced during the coking operating to be saved. At the end of the burning period, the coke is pushed out at the back of the oven by an electric ram and is there cooled and broken up into convenient sizes, and afterward taken away from the bench by electrically-operated coke cars, either to the blast furnace or to the stock bins, as may be required. Each of the four coke cars is operated by a 35-hp railway-type motor, which controls all of the movements of a car.

The Kopper ovens give an output 10 per cent. in excess of the old beehive equipment, and effect a saving by the use of the gas and the sale of by-products of about $100,000 per year. The gas is almost identical with the ordinary illuminating gas, and the by-products, such as tar, sulphate of ammonia, etc., are extracted from it in the usual way, some of the purified gas, as previously mentioned, being used in the coking process, the rest being led to a holder for supplying gas to two of the engines in the power house and for various other purposes as hereafter described.

The manufacture of pig iron is carried on in two blast furnaces, located at about the center of the site. These are supplied with calcined ore, limestone and coke from two large hoppers, or bins, close at hand, which discharge into the skip of the Brown hoist-charging equipment by means of endless belts, the various ingredients being automatically weighed during the passage from the bin to the blast furnace. The calcined iron and limestone are delivered to these bins by means of the gantry previously mentioned. The whole process of charging the furnaces is done mechanically, no men being situated at the top of the furnaces. The original blast furnace plant consisted of five furnaces, each 75 ft. high, and with 24 ft. bosh, requiring five blowing engines, the blast being heated in 12 Cowper stoves. These furnaces have been replaced by the present pair, each of which is 90 ft. high, with 11½ ft. hearth, and 21 ft. bosh, designed for a maximum output of 1400 tons per week.

The blowing engines, which are a notable feature of the blast furnace plant, consist of seven Cockerill gas engines, of Messrs. Richardsons, Westgarth & Company's manufacture. Cooling water for the pistons and cylinder jackets of these gas engines

is supplied from a tank which is in its turn supplied from a Morrison cooling tower, the water being pumped from the engines to the tower by means of two Gwynnes centrifugal pumps, each driven by a 70-hp motor; the cooling water is pumped through the cooling-tower and to the supply tank by four pumps, driven by 32-hp compound-wound motors; each engine is fitted with an electrically-worked "barring" arrangement

FIG. 5.—SKID AND ROLLER GEAR DRIVEN BY RAILWAY TYPE MOTOR.

operated in each case by a 10-hp series-wound motor. The engine house is spanned by an electrically-operated, 20-ton three-motor crane built by Booth Bros., of Rodley.

The gas from the blast furnaces, which, when the latter are in full operation amounts to about 63,000 cu. ft. per minute, is used partly in the blowing engines and partly in the Cowper stoves for heating the blast; it is, however, thoroughly cleaned before being used. The latter operation is accomplished by means of ingenious arrangements of the piping, and by gas washers, the washing plant consisting of three Theisen washers, each of which is operated by a 150-hp compound-wound motor. Two of these washers are capable of dealing with all of the gas from the two furnaces, the third being installed as a standby. The gas goes into the washers at a temperature of from 300 deg. to 400 deg. Fahr., and with from 2 to 4 grammes of dust per cubic meter, and comes out at a temperature of 70 deg. with only .016 to .02 gramme per cubic meter, and is then suitable for the gas engines. This is believed to be the first instance in the history of iron making in which all of the blast furnace gas has been freed from dust before being used.

The process of making steel is a very interesting one, the plant erected for its manufacture being arranged according to the Talbot continuous process. The plant is the largest of this type yet erected in Great Britain. The continuous system of making steel by the Talbot process is as follows:

At the commencement of a run, steel scrap is put into the furnace; this is melted with the necessary re-agents, and metal from the mixer is poured into a hot-metal ladle, and carried to the ingot molds, the remainder being then over-oxidized by the addition of suitable materials and additional metal is poured in from the mixer.

The actual process at the Cargo Fleet Iron Works is as follows:

The iron from the blast furnaces is run into 20-ton and 25-ton hot-metal ladles carried on standard-gage trucks, which are then hauled by steam locomotives to the steel plant. On arriving close to the two metal mixers, each of which is capable of holding 150 tons and fired by means of gas from the coke ovens, the metal is poured into the mixer and some of the sulphur and silicon eliminated. On the charging side of the plant are two 40-ton cranes, each fitted with six series-wound motors, the total rating amounting to 175 hp per crane. From the mixers the metal is carried in a 20-ton ladle by means of one of the aforesaid cranes to the Richardsons-Westgarth Talbot furnaces, of which there are three, each being of 175 tons rating. On the pouring side of the furnaces there are two 75-ton cranes, each equipped with series motors; these cranes carry the ladles to the ingot molds, and pour the metal into molds holding from 3 to 5 tons. The ingots after being cast are taken on special cars hauled by steam locomotives to the stripping house, where the molds are stripped off and the ingots put directly into the soaking pit until required in the rolling mill. The slag from the steel furnaces is run out at the back into slag bogies, and is taken away to a special basic slag plant, which has been put down in order to crush the slag for agricultural purposes. The gas for firing the steel furnaces is made in 10 Talbot producers, from which the gas is then led to the furnaces through large regenerators in much the same manner as in a Siemens furnace.

The next process in the manufacture of the structural steel is that of cogging. This is done by a cogging mill having 40-in. centers, and 8-ft. 6-in. rolls, and driven by an 18,000-hp, three-cylinder, vertical-compound condensing engine built by Richardsons-Westgarth. The soaking pits are gas fired, surplus gas from the Talbot furnaces being used for this purpose, and are spanned by a 15-ton Broadbent crane and a mast crane of the Stuckenholtz type, the former being equipped with four electric motors. From the soaking pits, the reheated ingots are lifted by a 15-ton crane and placed on a mechanical chair for conveyance to the cogging mill. After being cogged down to the required size, the ingots are fed by further live roller gear to the bloom shears, where they are cut up into the required lengths. The live roller gear at the back and front of the mill is operated by four 55-hp railway-type motors to each set of rolls, the only persons required in the mill being a man and two boys for the control of the live roller gear, and one man for the cogging mill engine. From the bloom shears the blooms are transferred to the Collins charger by a shear transfer table and are taken by means of the Collins charger, operated by four 20-hp and one 10-hp electric motors, into either a gas-fired heating furnace, where they are reheated preparatory to the finishing rolling process, or directly to the mill, as the case may be. The cogging mill is spanned by a 40-ton crane, operated by three electric motors for the changing of rolls and other operations connected with the cogging plant.

From the reheating furnaces the blooms go to the finishing mill. This mill consists of four sets of rolls driven by a steam engine of the same size and type as that driving the cogging mill. The reheated bloom is placed on a live roller table and carried to the first pair of rolls and passed in succession through the four pairs of rolls by means of traveling tables on both sides. From the last pair the piece is carried forward by means

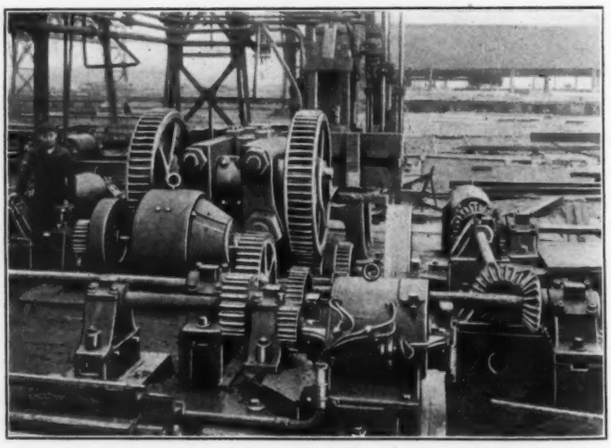


FIG. 6.—BEAM OR GIRDER STRAIGHTENING MACHINE.

of an extended roller rack to the hot saw or shears as may be desired. The hot saw is driven by a 100-hp shunt-wound motor; the live roller gear is also electrically operated by means of 20-hp tramway-type, series-wound motors. The finishing mill is equipped with a 60-ton electrically-operated crane, fitted with series-wound 22-hp and 20-hp motors for the main and auxiliary hoists, and 15-hp and 6-hp motors for the longitudinal and cross

traverse, respectively. Under this crane are also the roll-turning shop and the roll stores, so that when changes of rolls and repairs are necessary, they can be very easily carried out with the aid of this crane.

Beyond the finishing mill is a hot bank for cooling purposes, measuring some 100 ft. x 52 ft. From this bank the finished sections are fed by live-roller gear through the straightening machines to the shears, where they are cut into convenient and standard lengths. The hot bank is operated by eight 20-hp motors; four of these are on the live rolls and four on the skid gear. The angle and beam straightening machines are all electrically driven, the former being by means of a 55-hp motor and the latter by means of a 30-hp, shunt-wound motor. The beam or girder straightening machine is for straightening beams and girders up to 24 in. x 7.5 in., the live roller gear on either side being operated by a 20-hp series-wound motor. The head stock for straightening different sizes of beams is run in or out by means of a 5-hp series motor. The hot bank and straightening gear are spanned by two 10-ton gantry cranes, each equipped with three crane-type motors. The rail bank is equipped with two double-sided and one angle-sided electrically-driven straightener made by Messrs. Craig & Donald, the motor in the case of the first machine being rated at 20 hp and in the case of the single sided machine 15 hp, each machine being self-contained. In addition there are three ending machines and five drilling machines, all driven by electric motors.

The water for use throughout the works is obtained from the town, and a considerable quantity from the Tees, the water being pumped from the latter by means of two Mather & Platt turbine pumps operated by 70-hp motors.

Italian 12,000-hp Steam Turbo-Generator.

The accompanying illustrations give views of a 12,000-hp steam turbo-generator and auxiliary apparatus built by Franco Tosi, of Legnano, Italy, for central-station service. The turbine, which is of the Parsons type, is designed for 175-lb. steam pressure and 300 deg. C. supertemperature. It drives a Brown, Boveri & Company 25-cycle, 12,000-volt, three-phase generator at 750 r.p.m. It is stated that the steam consumption at full load is 14.1 lb. per kw-hour.

The turbine is connected to the alternator by a flexible coupling. The turbine bearings are lubricated with oil under a pressure of 22 lb. per sq. in. by means of a self-contained oil pump. Use is made of a small auxiliary steam pump to supply oil to the bearings during the starting period. The steam piping is so arranged that steam cannot be admitted initially to the turbine until the auxiliary pump has been started. Moreover, if the oil supply should fail, the turbine is brought to rest automatically.

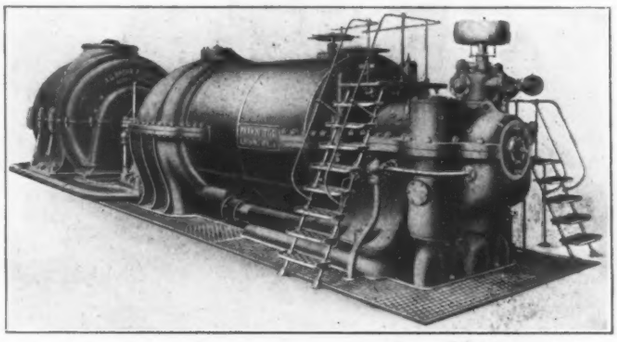
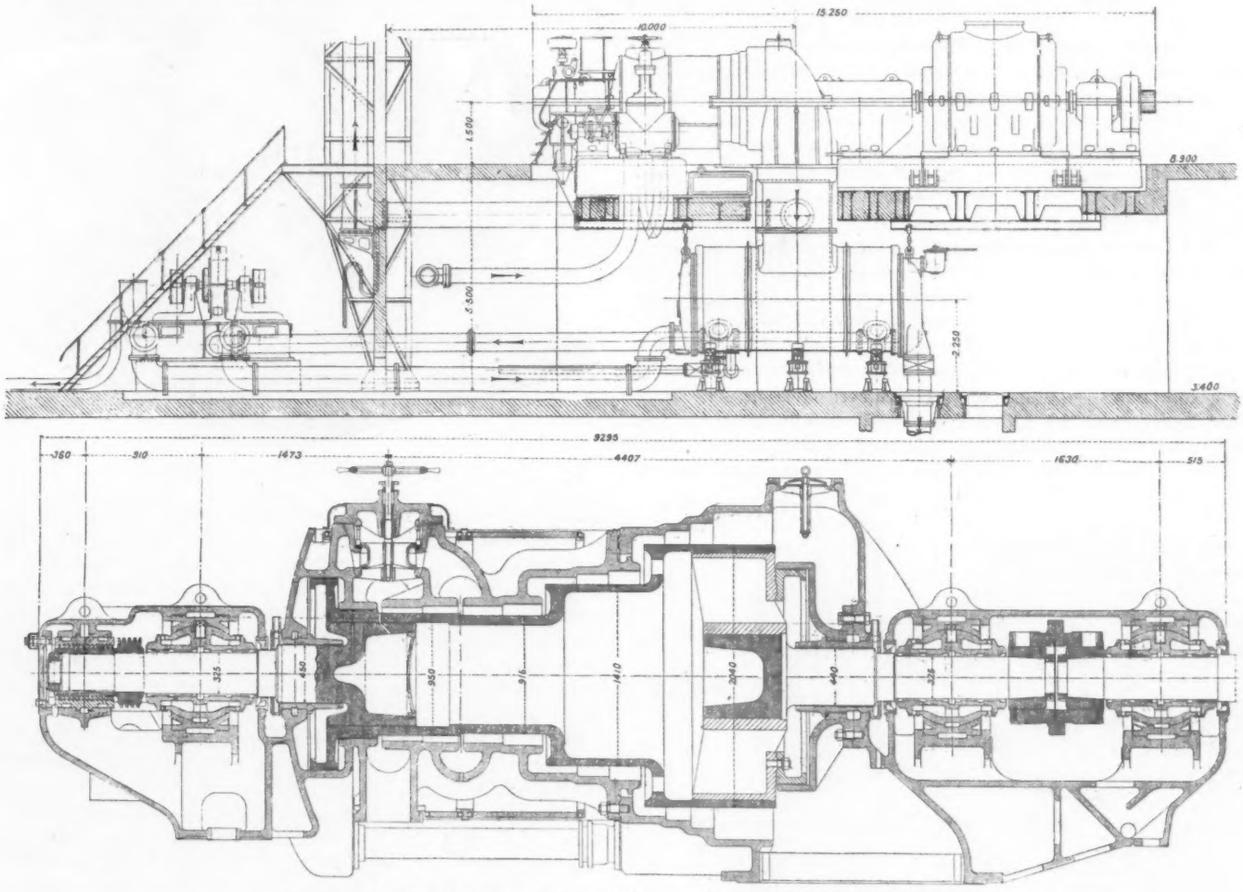


FIG. 1.—TOSI 12,000-HP TURBO-ALTERNATOR.



FIGS. 2 AND 3.—DETAIL AND SECTIONAL VIEWS OF TURBO-ALTERNATOR.

The condenser, which is of the surface type, is served by a wet air pump. This pump consists of two double-acting cylinders driven at 145 r.p.m. by an 80-hp direct-current motor. The air which accumulates in the higher parts is removed by means of a special pump. Two centrifugal pumps working in parallel serve for circulating the water; each pump is driven

by a 90-hp direct-current motor. A complete syphon system is maintained in the circulation water pipes, so that the work

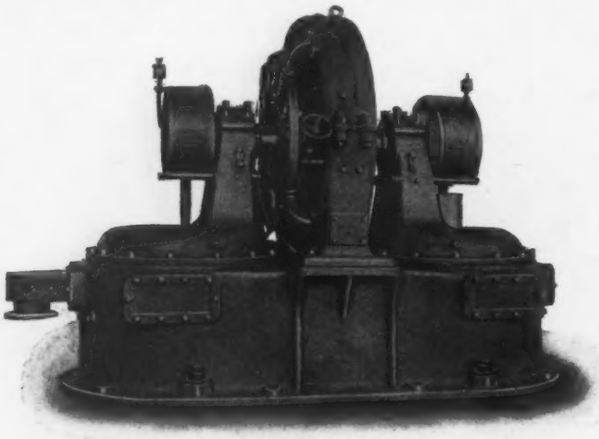


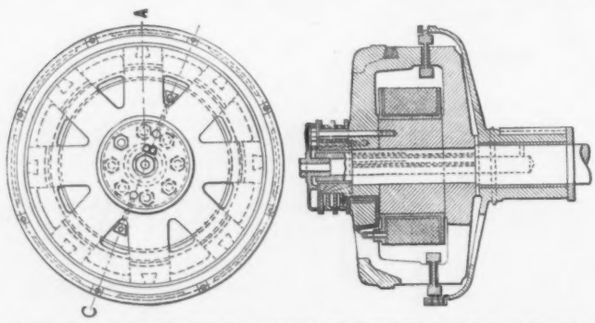
FIG. 4.—MOTOR-DRIVEN RECIPROCATING AIR PUMP.

required of the centrifugal pumps is kept at the minimum value.

The Induction-Type Clutch.

For many purposes it is desirable to drive heavy machinery that must be frequently and quickly started and reversed by a combination of a continuously-running motor and clutch-gearing of suitable design rather than by a reversing motor, the advantages becoming more pronounced the more frequent the reversing and the quicker the acceleration demanded. An induction clutch designed for the conditions here assumed is shown in Figs. 1 and 2.

Referring to Fig. 2, the relatively light spider, containing at its center a bearing bushing loose on the shaft and at its circumference holding a ring of copper, is the driven member of the clutch. This driven member may deliver power directly or through a pulley or pinion mounted on its hub. All other parts carried on the shaft revolve with the shaft and are parts of the continuously-running driving member. The driving member, apart from the collector rings attached to it on the left, has only three parts, namely, two steel castings and a bobbin between them holding the exciting coil. The two steel castings



FIGS. 1 AND 2.—SECTIONAL VIEWS OF INDUCTION-TYPE CLUTCH.

form a magnetic circuit, broken by the air-gap at the circumference, in which gap the copper ring is situated. The steel castings are cut away at the outside so as to concentrate the magnetic flux at eight poles, leaving between them spaces in which there are no magnetic lines except the few due to leakage. The copper ring is allowed ample running clearance between the oppositely-facing poles.

When current exists in the exciting coil, and the driving member is revolving, the copper ring is dragged after the driving member by mutual attraction of the magnetic flux and the eddy currents set up in the copper, an action known as an "eddy-current drag." The action is the same as that of the induction motor except that in this case the revolving field is a field fixed relative to the driving member and revolved mechanically by revolving that member. The clutch is thrown into action by introducing current into the exciting coil through brushes which bear on the collector rings. When this circuit is broken the clutch instantly releases and no force whatever is exerted on the driven member.

The forces brought to bear on the copper ring are entirely in a tangential direction, hence there is no tendency whatever for the ring to be drawn over to the poles on either side. For this reason there is no wear at all in the clutch since there is no friction. The relations between slip and torque are substantially the same as those obtaining in the case of the induction motor, and the well-known variations in slip-torque relations that can be produced in the induction motor by varying the conductivity of the secondary circuits are here obtained by designing the ring with greater or less thickness in web or flanges, or both, or by varying the strength of the exciting current.

In rating these clutches the temperature rise is not considered as the limiting factor as is the case with dynamos and motors, because all parts are designed to withstand very high tempera-

FIG. 3.—INDUCTION-TYPE CLUTCH.

tures, the copper ring of itself being indestructible, and the exciting coil being wound with asbestos-covered wire. The clutches are rated at the pull which they can exert, and it is immaterial whether this pull is exerted only momentarily or continuously so far as consideration of temperature is concerned. The clutches are remarkably small as compared with the motors whose power they transmit, a clutch having an efficiency of 90 per cent weighing only one-seventh as much as the motor with which it is used.

Fig. 3 shows an induction clutch, such as are used in driving reversing tables and manipulators in the Bethlehem Steel Works, where 13 are installed.

This clutch is capable of being applied in numerous connections simply as a clutch to be thrown in and out by closing or opening the exciting circuit. It has the property of positively protecting the driving and driven machinery against overload beyond the capacity of the clutch, which capacity is under control by fixing the strength of the exciting current. The clutch of itself is fool-proof against injury from overload or stalling.

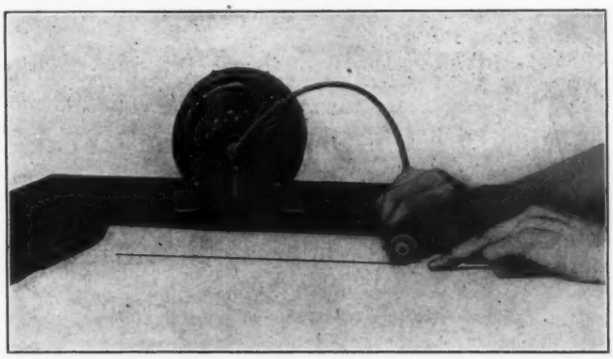
In connection with reversing drives, the field in which the clutch seems best adapted is that of driving reversing rolling-mill tables, metal planers, elevators, mine hoists and reversing rolling mills, using power from either direct- or alternate-current continuously-running motors.

Exclusive rights to the manufacture and sale of the induction clutch in various forms, and of the induction drive, are held

by the Wheeling Mold & Foundry Company, of Wheeling, W. Va., under patents taken out by A. P. Steckel, of Buffalo, N. Y., and F. du P. Thomson, of Wheeling, W. Va.

Motor-Driven Eraser.

In even the most careful work in engineering offices and drafting rooms mistakes will occasionally be made, and changes are frequently necessary, requiring alterations in tracings. It is well known by draftsmen that erasing with a very light fast motion will remove the lines without a scar. But most draftsmen do not have the patience to do the work without putting too great a pressure on the rubber, and the result is a marred tracing. The use of a scratcher leaves the poorest



MOTOR-DRIVEN ERASER.

job of all. For these reasons an eraser driven by a small electric motor finds great favor among draftsmen.

The eraser shown in the illustration is connected to the small Westinghouse motor by a Coates flexible shaft, allowing the motor to remain in one position near the edge of the table from which any spot in the drawing may be reached. If desired the motor may be carried from table to table, as it is light in weight. In some cases all tracings, etc., requiring correction are brought to a separate bench used for erasing.

The motor is of either the direct-current or alternating-current type rated at 1/12 or ⅛ hp. The complete outfit is supplied by the Coates Clipper Manufacturing Company, of Worcester, Mass.

Tungsten Lamp Fixture.

The growing interest in series incandescent street lighting since the introduction of the tungsten lamp has resulted in the

TUNGSTEN LAMP FIXTURE.

improvement of fixtures for this purpose, and one of the latest designs of this class, made by the Wheeler Reflector Company, of Boston, is shown in the accompanying illustration.

This consists of an 18-in. porcelain-enameled steel reflector, fluted to give the most effective candle-power distribution and protected by a copper or painted steel hood attached to a cast holder. The illustration shows malleable iron cross-arms supporting pony glass insulators in a vertical position, but these may be cast in one piece with the holders so that the insulators may be held at right angles to the stem. The mica insulating joint is designed for high-tension circuits and will stand a breakdown test of 34,000 volts. The important feature of this fixture, however, is the reflector, which besides being fluted and slightly convex, is adjusted at such an angle with relation to the filament and of a sufficient diameter (18 in.) to intercept the light radiated in the direction of the base. With a 40-cp lamp the light distributed shows a curve beginning at about 45 cp at the horizontal, increasing to 50 cp at nearly every angle from 20 deg. to 40 deg. below the horizontal, then gradually dropping to 40 cp at 60 deg., and 25 cp in the direction of the tip.

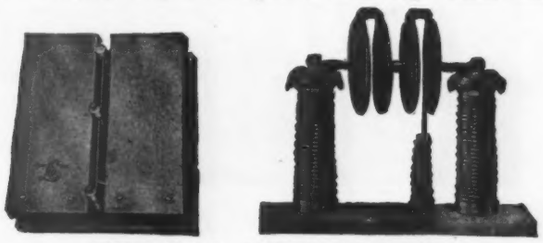
Sheet Steel Metal Locker.

A locker for general use, which is made entirely of sheet steel and is provided with two ventilators, one at the top and the other at the bottom, is illustrated herewith. The backs, divisions and end panels of these lockers are made of No. 24 gage sheet steel, the doors having ornamental perforations for ventilation and a lap joint to ensure a tight fit. The frames are made of steel angles and each locker is equipped with one shelf, three coat hooks, individual number plates and a special three-point locking device, which fastens the door at the top, center and bottom with a single turn of the handle. The latter is operated in connection with a dead spring bolt rim lock or brass padlock. The lockers are made in standard sizes with flat or slanting top, by Edward Darby & Sons Company, Philadelphia, Pa. These sizes, as adopted by this company, measure 12 x 12 x 60 in. high; 12 x 12 x 72 in. high, and 12 x 18 x 72 in. high. The lockers are finished in Tuscan red, olive green or black enamel, but may be finished in any other style desired.

METAL LOCKER.

Laminar Choke Coil.

The type of choke coil illustrated herewith is designed particularly for direct-current stationary motors and for series arcs, as well as for alternating-current circuits of low frequency. It differs from the ordinary type by reason of there being alternate bands of copper and iron, the copper being entirely insulated from its magnetic neighbor by an insulating ribbon. The insulated member, which is entirely free from the circuit and acts purely as an inductive collector, traverses each of the conducting turns of the choke coil and absorbs from the current-carrying strip the surplus static charge which otherwise would have leaked through the coil; and as the discharge rod is in close proximity to the upper edge of the insulated members, it readily carries away the static charge gathered on



FIGS. 1 AND 2.—LAMINAR CHOKE COIL.

their surfaces. The discharge rod is connected directly to earth through a "Par" lightning arrester. The copper ribbons, which are bare, are wound in sufficient numbers and of given size and capacity to conform to the circuit upon which it is to be placed.

An open type is also made, which is mounted on strips of marble or slate and when necessary is assembled in gangs to take care of very heavy currents. To increase its insulating properties for higher tensions it is mounted in a case surrounded by oil. All of the features of the discharge rod are retained, but the insulating properties are raised by reason of this emersion in the insulating fluid. This coil, like the other, is cut into the main circuit and acts as the choke coil to strengthen the insulation of the apparatus. Its discharge to ground is very sensitive in action by reason of the secondary ground outlet through the "Par" lightning arrester. These choke coils are made by the Lord Electric Company, of New York.

Gas-Fired Insulators for Transmission Lines.

The New Lexington High-Voltage Porcelain Company, of New Mexico, Ohio, has adopted natural gas exclusively for use in the kilns in which are fired the insulators which it manufactures for transmission line service. It is claimed that the gas-firing has two distinct advantages:

First, it eliminates from the glaze of the insulator all the impurities deposited when the insulator is burned in a coal-fired kiln. There may be a considerable amount of metallic substance in the impurities, but the principal difficulty is experienced from the sulphur in coal, which is deposited in the glaze of the insulator, which leads to arcing over under test at a lower voltage than it otherwise would. After this arcing, streaks will be found on the surface of the insulator which look somewhat like crazing; these cannot be removed and act as a sure tell-tale for sulphur in the glaze.

Second, it is naturally much easier to regulate 12 gas burners, by merely turning the valve a little one way or the other, in order to keep the temperature in all parts of the kiln the same, than it is to regulate 12 coal fires to accomplish the same result. In gas-firing, therefore, a more even temperature is obtained throughout the kiln, and when the insulators are drawn from it, they are of uniform color and vitrification, free from foreign matter, and in general have a cleaner and neater appearance than is possible with the use of coal. The above considerations indicate that an increased reliability in the service may be obtained with gas-fired insulators, accompanied with a decreased feeling of worry on account of interruptions caused by faulty insulators, on the part of the operating superintendent.

Switch for Starting Induction Motors.

The switch illustrated in Fig. 1 has been developed to eliminate the auto-transformer starter used with three-phase induction motors. By means of this switch it is possible to start a motor at what is the equivalent of 57.8 per cent of the running e.m.f. without using an auto-transformer. The phase

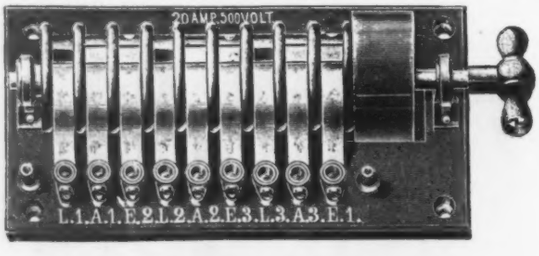
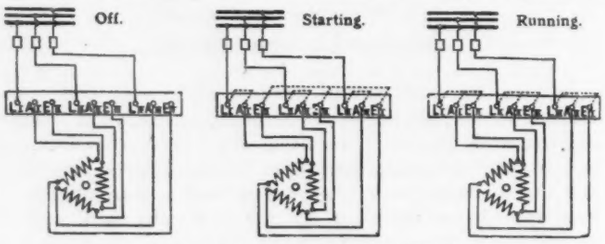


FIG. 1.—STARTING SWITCH.

windings of the motor are not permanently joined together, but are connected to six separate binding posts on the machine. By means of the switch, the three windings are arranged in star-connection for starting and in delta-connection for normal running. The interconnections of the six binding posts and the supply leads in the "off," "starting" and "running" positions of the switch are shown in Figs. 2, 3 and 4,



FIGS. 2, 3 AND 4.—CIRCUIT DIAGRAMS.

respectively. It will be noted that in the "off" position all of the phase winding connections are interrupted, hence no additional main-circuit switch is required.

This switch is manufactured by the Bergmann Electrical Works, Berlin, Germany.

Safety "All-in-One" Wireman's Tool.

Wiremen usually require three different tools to cut wires, strip the insulation and make loops or eyes, viz.: side-cutting pliers, a knife and round-nose pliers. The implement illustrated herewith embodies all three of these instruments, and the three operations may be thus performed by the use of one tool. With this device insulation may be stripped from flexible cord without cutting any of the strands and without any possibility of cutting the fingers, as is common when the insulation is stripped

WIREMAN'S TOOL.

by the use of a knife. Insulation can also be rapidly removed from the ends of rubber covered wire, and the wire can be looped into an eye to fit any size screw, without danger of scoring the wire. Where it is desired to tap a wire for connecting a rosette or a branch, a section of the insulation can be readily removed with this tool without scoring the wire.

Obviously this tool is a time-saving instrument, and as far as the stripping of insulation is concerned, performs this work with greater safety and speed than is possible by the old method. The looping or eye-making device consists of two round studs, *A* and *B*, on the end of the jaws. One is adapted to loop for a No. 6 screw and the other for a No. 8 screw. The wire stripper consists of a guide hole, *C*, extending nearly through the handles, ending in a thin cutter with a small wire clearance hole in the centre (*D*) with rounded edges.

The implement is 6 in. long and is used for No. 12 and No. 14 rubber covered wire, and No. 16 and No. 18 flexible cord. It is made by the Marshall Electric Company, Boston, Mass.

Field Coil Pads.

The Massachusetts Chemical Company, of Walpole, Mass., operating the Walpole Rubber Works and Varnish Works, has changed the name of one of its products, formerly known as "Field Coil Cushions," to "Field Coil Pads." These pads are used to take up all play between the field coils and adjacent parts, thereby doing away with chafing and resulting grounds through the field pieces. Formerly canvas sheets were cut to fit over the field pieces, and several such sheets were stuck together, making an unyielding washer which quickly wore out. The rubber field coil pads "give and take" sufficiently to prevent any looseness caused by expansion and contraction, and are claimed to be so easily applied as to save their cost in the time and labor saved.

New Types of Resistance Unit.

The accompanying illustrations show new types of resistance units brought out by Charles Wirt & Company, of Philadelphia. These are of the "Di-e-lite" construction and contain several novel features. Both forms illustrated are "ironclad"

FIG. 1.—RESISTANCE UNIT.

and are wound with zero coefficient wire. The body is of solid "Di-e-lite" (insulating stone). Fig. 1 has terminals which project through the supporting slate slab and serve for attachment, being sufficiently strong for this use. Fig. 2 has a cast-iron cradle or bracket with feet for attaching, and outwardly turned binding posts to facilitate connection in close quarters. A common size of such units is 1½ in. diameter and 7½ in. long.

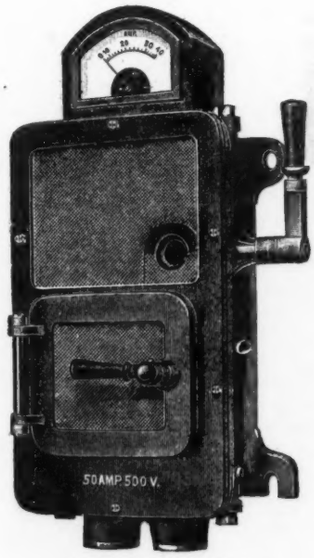
FIG. 2.—RESISTANCE UNIT.

They may be made of any size up to that of a length of stovepipe. "Di-e-lite" is claimed to possess a large heat capacity, is purely mineral and is unaffected by temperatures below red heat. When iron-clad, units of this construction have the qualities demanded by modern engineering practice—ability to stand very rough usage, mechanical and electrical.

Motor Switch Boxes for Use in Mines.

The Bergmann Electrical Works, of Berlin, Germany, have brought out a motor switch-box, as shown in the accompanying illustration, which is largely used in mines and similar places. In designing these motor switch-boxes special attention has been paid to mechanical strength, high insulation and reliability in working. The switch, fuses and ammeter are enclosed in a cast-iron case, and all joints are made completely watertight so that the switch boxes may be used in damp or wet places. The switch is of the double-break pattern for each pole and has a quick-break action. The position of the switch can be observed through a small glass window, a red indicator appearing when the switch is closed. The fuses are accessible through a door, but as the latter can only be opened when the switch is open, the fuses cannot be replaced except when the line is dead, and the switch cannot be reinserted until the fuse door is closed. Mica is used throughout for insulating all current-carrying parts, such as switch and fuses.

The terminals are arranged for cartridge fuses, but any kind of fuse can be fitted to order. Standard switch boxes are supplied with connections underneath the bottom of the box. The ammeters are of the soft-iron type fitted with air-damping arrangement. If desired, however, dead-beat, moving-coil instruments for direct current can be supplied. The ammeters have two scales; one is calibrated in amperes and the other in horse-power. Switch boxes are built for direct-, single- or three-phase current with or without an ammeter. The cable inlets can be removed and, if desired, connecting plates can be supplied suitable for conduit. The Bergmann Electrical Works are represented in Great Britain by Messrs. Marples, Leach & Company, Limited, Adnil Building, Artillery Lane, London, E. C.



MOTOR SWITCH-BOX.

Incandescent Lamp Guard.

The Underwriters require that an incandescent lamp exposed to contact with materials of an inflammable nature shall be inclosed in a wire guard so constructed that in no case can the lamp come nearer than 1 in. to such materials. In order to meet these requirements a guard must be attached rigidly to the lamp socket and the central part of the guard held at least 1 in. away from the lamp in all directions. A lamp guard which meets these requirements in every respect is shown in Figs. 1 and 2, made by W. N. Matthews & Brother, of St. Louis, and known as "The Holdfast" guard. It will be seen that the guard is clamped securely to the lamp socket and can be locked there permanently against removal by irresponsible persons. The inner spiral cushion serves to hold the lamp always in the same position with reference to the outside spreading ring, and at the same time will take up any vibration due to a sudden impact upon the outside protecting wires. These guards are made of four different weights of wire to meet all conditions of rough usage. The lightest is made of No. 18 wire and is used in places where the lamp is not normally exposed to severe blows from moving objects. Other guards are made of Nos. 14, 13 and 12 wire and are recommended for use in machine shops, in warehouses and on hand portables.

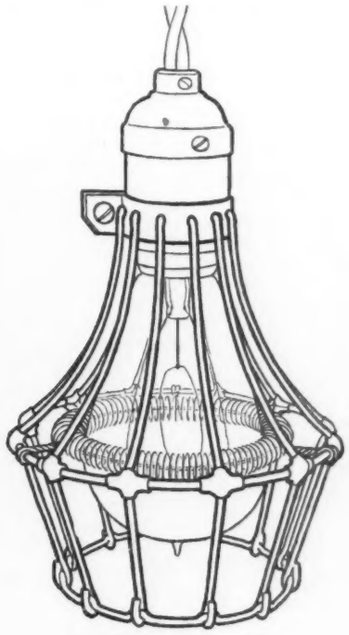


FIG. 1.—LAMP GUARD.

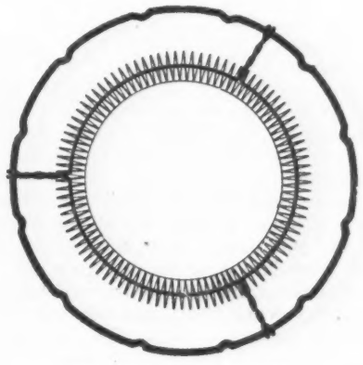


FIG. 2.—SPIRAL CUSHION.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

Seasonable weather and increased manufacturing activity in the principal lines during the last week were the dominant features in the general trade situation and resulted in a continued improvement in commercial channels. Less idle machinery is reported and retail trade shows improvement as payrolls increase and as the situation strengthens on the prospect of good crops. Wholesale trade reports are also more optimistic. The slowness of collections, which are but little improved, reflect the backward position of the country as compared to a year ago. Money continues easy, but the influx from the country to the city has slackened off noticeably. Building expenditures in May were 29 per cent smaller than in April and 41 per cent less than in May, 1907. Following the rush in pig iron orders, the market was marked up and the placing of orders slackened. Reductions in certain lines of steel and iron did not bring out any amount of orders, as still lower prices are looked for. Failures for the week ended June 4 number 225, according to *Bradstreet's*, and are the smallest total reported for any week since last October. They compare with 263 in the preceding week, 155 in the like week in 1907, 162 in 1906, 194 in 1905, and 171 in 1904. Failures for the month of May numbered 1103, the largest number ever reported in that month, but slightly less than in either of the three preceding months. A somewhat better demand for electrical manufactures is reported and a number of large orders that were held up on account of the money stringency will be presently given out when the details of financing have been completed. The Westinghouse Electric & Manufacturing Company reports a better business for May than over any of the months since the beginning of the year, and Allis-Chalmers earnings for April were $250,000 in excess of the earnings reported in the preceding months. The earnings for the first seven months of the current fiscal year are understood to have exceeded all fixed charges, including interest, by $535,000. The Western Electric's domestic orders for April were 15 per cent better than the March showing, but the foreign business shows a slight decrease from March. The business of the Western Electric Company in 1906 was, in round numbers, $70,000,000. The next year it receded to about $50,000,000, and this year, it is estimated, will run between $25,000,000 and $30,000,000.

THE COPPER MARKET.

There was less activity in the copper market during the last week than during any other week since the first of the year. The only vitality shown was in the standard market, where prices are being maintained by speculation. As long as there is a profit in buying spot standard and selling future standard under the present price fluctuations, the speculative movement will be maintained, but a prevailing opinion is that according to the laws of supply and demand copper should now be selling at 12 cents or less. Although bare of stocks, the large consumers are holding off to see what the effect on the market will be from the influx from the reopened mines, which is due this month. The General Electric Company, which is reported to have cash on hand and in the banks aggregating between $15,000,000 and $18,000,000, has not entered the copper market for more than amounts required for immediate needs, and this is the attitude of practically all the large consumers. Although a large part of the heavy exports during the last six months have gone into consumption, there are still heavy supplies on hand in European warehouses, and Japanese interests are under pressure to sell spot copper in London, thus precluding the hope of unusual exports. The opening of this week showed little change in the situation, the dulness, perhaps, being a little more marked. There are those, however, who profess to take an optimistic view of the situation. The fact that several of the large selling agencies have refused to accept offers for large blocks of metal for future delivery around 13 cents a pound seems to indicate that producers, at least, feel confident of an early revival in demand. D. Houston & Company say: "There is not the slightest reason to imagine that copper will continue to suffer indefinitely under the disadvantage of a restricted demand. A tremendous expansion in the use of the metal is bound to follow the economical and conservative policy now practiced at the various melting establishments. Present prices of copper are at such a low level, and stocks in manufacturers' hands have been so much reduced, that the resumption of a brisk industrial demand ought to be hastened by sheer necessity." May exports showed a sharp decline from April exports, but a large increase over the exports for May, 1907. The decrease from April amounted to 9,113 tons, while the increase over May, 1907, which, however, marked a low record in exports for the last decade, was 16,630 tons. Monday's closing prices on the Metal Exchange were as follows:

Lake	12¾ @ 12⅞
Electrolytic	12½ @ 12¾
Castings	12⅜ @ 12½

Owing to the holiday in London, Friday's prices are quoted as follows:

	Noon. £	s	d	*Close. £	s	d
Standard copper, spot	58	2	6	..	..	.
Standard copper, futures	58	12	6	..	..	.
Market	Steady.			.....		
Sales of spot	100 tons					
Sales of futures	400 tons					

*Closed until Tuesday.

Extreme fluctuations for the year:

	Highest.			Lowest.		
Electrolytic copper, spot	13¾			12¼		
Lake copper, spot	13⅞			12⅜		
Casting copper, spot	13½			12⅜		
London, spot	£64	5	0	£56	10	0
London, futures	64	10	0	56	17	0
London, best selected	67	10	0	60	5	0

FOX BROS. & COMPANY, 126 Lafayette Street, New York, have recently established an electrical department in connection with their railway and mill supply business. This new department will handle the line of arc lamps made by the Carbone Licht Gesellschaft of Germany, for which company they will be sole agents in the United States and Canada. This line of lamps includes the Carbone lamp, Radiante lamp, Phalanx lamp and Polar flaming arc. The Carbone lamp, which has attracted much attention since its invention several years ago, gives a fine white light and has an efficiency somewhat greater than that of the open arc. The Radiante lamp burns 40 hours on one trim and the quality of the light is particularly good for interior illumination, as in stores, offices, and in the textile industry where color values are important. The Phalanx lamp is the same lamp adapted for alternating currents. The Radiante Economy lamp takes 4 amperes and burns 32 hours on one trim. The light is white and soft and represents an efficiency nearly double that of the enclosed arc. The Polar flaming arc is made for both alternating and direct current. The large size burns 20 hours on one trim and the economy claimed is .25 watt per English candle. All of the above lamps have already passed into large use in Europe. D. D. Miller and Louis J. Auerbacher will have charge of the Fox electrical department. Mr. Miller, who was for many years in the sales department of the Westinghouse Company, will supervise the sales. Mr. Auerbacher has made a specialty from the beginning of the various recent great developments in arc lighting, and in several trips to Europe has thoroughly studied the various types of new arcs both in operation and construction, and also the processes of manufacture of the special carbons employed.

TO BOOM EXPORT TRADE.—With the purpose in view of extending American foreign trade, a committee of the directors of the Illinois Manufacturers' Association has decided to go abroad within the next six months. The committee, consisting of 200 members of the association, will visit Japan, China, Korea and the Philippines and other foreign countries. A special steamer, the first of a new line which will ply between America and the Far East, will transport the committee to Japan.

ELECTRICAL EXPORTS.—Exports of electrical appliances, including telegraph and telephone instruments, for the month of April, 1908, were valued at $586,427, an increase over the value of similar exports for the same month in 1907, which totaled $583,780. Brazil headed the list of countries importing this class of goods, with imports valued at $88,035, British North America was second with imports valued at $82,699, and Mexico third with $75,950. Exports for the 10 months ending with April, 1908, totaled $5,868,371, as compared with $6,868,971 for the same period in 1907 and $5,405,379 in 1906. Exports of electrical machinery to foreign countries valued at $566,586 for the month of April, 1908, showed a marked falling off from like exports in the same month in 1907, which were valued at $748,618. Japan headed the list of countries importing this class of electrical goods with imports valued at $187,693; the United Kingdom was second with $50,504, and Mexico third with imports valued at $48,891. For the 10 months ending April, 1908, the exports of electrical machinery from the United States totaled $7,366,634, an increase over the same period in 1907, when the exports were valued at $7,124,240. From the above it will be seen that although the exports of electrical appliances for April, 1908, increased over the exports for the same month in 1907, yet the exports of electrical machinery fell off from April, 1907, to the extent of $182,032. On the other hand, for the 10 months ending April, 1908, the exports of electrical machinery appliances, including telephone and telegraph instruments, fell off to the extent of $1,020,600 from the same period in 1907, while the exports of electrical machinery for the 10 months ending April, 1908, showed an increase of $242,394 over the corresponding period in 1907.

PLANT FOR CYANAMID.—The contract for the construction of the first cyanamid plant on this side of the water has been let by the American Cyanamid Company to Westinghouse, Church, Kerr & Company, of New York City. The contractors already have organized the work with men on the ground, and construction will be vigorously pushed in the expectation that the plant will be ready for operation in about 10 months. The plant is located at Niagara Falls on the Canadian side, and for the purposes of its present and future business the company has acquired an area of 26 acres. The initial capacity will be 7500 tons per annum, although the plans which have been prepared will permit the expansion of the industry at that point to 40,000 tons. There are 11 cyanamid plants in Europe projected, in process of construction, or in operation, and their aggregate annual capacity is 166,000 tons. Inasmuch as America supplies a considerable portion of the foodstuffs for Europe, it is thought likely that the expansion of the American plant for the purposes of agricultural fertilizer will be very rapid.

RITER-CONLEY $1,000,000 CONTRACT NEARING COMPLETION.—The contract which the Riter-Conley Company (Sharon) has with the Rio Janeiro Power Company, and involving in the neighborhood of $1,000,000, is nearing completion. The Riter-Conley Company contracted to furnish the feeder pipes, transmission line towers and structural material for the large hydro-electric plant of modern design, which the Rio Janeiro Light & Power Company is developing at Rio das Lages. The initial maximum capacity of this plant will be more than 50,000 hp, but the enormous storage capacity of the reservoir which is being constructed, and which has a capacity of 7,780,000,000 cu. ft., will enable the company to increase further the capacity of the station as business requires. It is estimated that a total capacity of at least 120,000 hp can be developed at this point if necessary. The turbines used in the work are being furnished by the Escher-Wyss Company, and the electrical apparatus is supplied by the Westinghouse Electric & Manufacturing Company.

SYNCHRONOUS MOTOR-GENERATOR IN CHLORINE PLANT.—The chlorine plant of the United States Reduction & Refining Company, at Colorado Springs, Col., has in operation an Allis-Chalmers 150-kw synchronous motor-generator set to supply electricity for the electrolytic production of chlorine used in the treatment of gold ores. MacDonald cells with carbon anodes and cast-iron tanks as cathodes and an electrolyte of salt solution are used in connection with the set. A syncronous motor-generator set was selected as best adapted for operation in connection with the cells because any serious drop in potential would cause the machine to fall out of step and release itself from the circuit. Otherwise the counter e.m.f. generated by the cells themselves would have a tendency to reverse the polarity of the generator. The set consists of a 225-hp synchronous motor coupled to a 150-kw generator. The motor is fed with three-phase, 440-volt, 60-cycle currents and the generator delivers direct-current at a potential of 150 volts.

WESTINGHOUSE BUSINESS.—In line with the report of improvement in the conditions at the works of the Westinghouse Electric & Manufacturing Company at East Pittsburg, it is said that during the month of May the shipments of finished material represented $2,250,000, or almost $700,000 more than the shipments during April. While the general business of the company still shows evidence of betterment, especially in the demand for small apparatus, it is not expected that there will be any unusual activity in the departments constructing large machines until the candidates for President have been selected. That this seems to be a fact is indicated by the many negotiations which are held in suspension for the present. Similar conditions exist at the Westinghouse Machine Company, although the latter has just secured a very important contract for gas engines and gas producers from the Durangueña Electric Company, of Durango, Mexico.

ACHESON LUBRICANTS.—Edward Goodrich Acheson has transferred to the Acheson Oildag Company his patents and trade-marks covering his latest important products, "Oildag" and "Aquadag." These patents and trade-marks cover the industrial world, 22 countries in all. Oildag has already obtained popularity as a gas-engine lubricant, the claim being made that its use makes possible a 50 per cent reduction in the oil consumption, at the same time greatly increasing the available power of the engine by decreasing the friction and increasing the compression, also quieting the engine and making it run like velvet. Oildag is also valuable in the operation of electric-light plants. It is a mixture of deflocculated, unctuous Acheson-Graphite mixed with oil, put up in tubes and cans for charging 1, 5 or 10 gal. of mineral oil. The Acheson Oildag Company has established offices and works at Niagara Falls, N. Y.

DUNCAN COMPANY TO MANUFACTURE TRANSFORMERS.—The Duncan Electric Manufacturing Company, Lafayette, Ind., has purchased the machinery, tools and business of the Lafayette Electrical Manufacturing Company, manufacturers of transformers. The transformer plant has been thoroughly rejuvenated and the most modern transformer manufacturing apparatus installed. The services of one of the most competent transformer engineers in the United States have been secured, and workmen are now engaged in installing an insulation impregnating outfit. A new departure in the testing of transformers is that of subjecting them to a higher breakdown test than has heretofore been customary, as an extra means of insuring the highest standard of dependability.

WESTINGHOUSE MOTORS FOR MEXICO.—The San Rafael Mineral Company, of Pachuca, Mexico, has placed an order with the Westinghouse Electric & Manufacturing Company for an electrical equipment for a stamp mill. The order, which came through the Westinghouse Mexican agent, includes eight motors and a switchboard. For the month of April, 1908, Mexico imported electrical machinery to the value of $48,891, and was the third largest importer of this class of machinery from the United States.

MOTOR MANUFACTURERS FORM ASSOCIATION.—A majority of the electric motor manufacturers of the country held a meeting at Hot Springs, Va., June 1, 2 and 3, at which an association was formed for the purpose of promoting better acquaintance among the manufacturers and the discussion of technical and commercial questions affecting the trade. The officers and permanent organization will be announced later.

THE BAY STATE LAMP COMPANY, of Danvers, Mass., has equipped a factory for the manufacture of "Hygrade" new lamps, which it will sell in addition to the "Bay State" lamp. The new lamp is stated to be the result of several years of experiment to meet every requirement for a high grade, uniform and lasting carbon filament lamp.

PIRELLI & COMPANY, MILAN.—Capt. G. L. Carden, special agent of the Department of Commerce and Labor, in a recent report, states that Pirelli & Company are now employing 5300 men in their works, the output of which consists of insulated wire and cables for all purposes, including the submarine telegraph, and also rubber tires.

SAN FRANCISCO TELEPHONE COMPANY ORDERS 17,000 TELEPHONES.—The Automatic Electric Company, of Chicago, has received an order from the Home Telephone & Telegraph Company, of San Francisco, to ship at once 15,000 telephones for that city, and 2000 for the plant at Berkeley, Cal.

Financial Intelligence.

THE WEEK IN WALL STREET.

The most significant feature of the stock market last week was the sudden loss of interest on the part of speculators—who have constituted principally the buying element during the recent activity—as soon as the announcement was made that the Union Pacific financing plans had been consummated by the sale of first mortgage bonds to banking houses in New York and Europe. The opinion of the speculative element seems to have been that prices were simply being pushed upward by large financial interests with a view of making a basis upon which to market these bonds. This transaction having been completed the professionals naturally concluded that it was a good time to take in profits, and the pressure to sell became more acute. Thus is explained the course of the market during the week. In the earlier days the advance was resumed, and there was some activity on the buying side. With modest transactions prices were not only sustained, but were slowly pushed a little higher. On Thursday, when the Union Pacific bond transaction was announced, the buying was checked and sellers were more largely in evidence. Prices in many instances sagged, and the volume of trading was curtailed. Net changes for the week show probably as many advances as losses, but the decline from midweek to the close was practically universal, and the activity was notably less. The reduction in the price of steel bars amounting to $4 per ton, while not directly reflected in the price movements of Wall Street, was generally accepted as a move tending toward the improvement of general trade conditions and therefore resultant eventually in an improved condition of securities. Manufacturers are of necessity benefited in any cheapening of raw material. The general impression prevails that other reductions in steel products will follow, and a general feeling of hopefulness for increased orders pervades the element interested in industrial securities. Another encouraging feature pointed to by the sanguine traders in the Street is the general easier tendency in the rates for money in all the financial centers of the world. The open market discounts in London and Paris were materially easier, and the official rates quoted by the banks of Germany, Sweden and the Netherlands were reduced. This tendency was, of course, reflected in Wall Street, and is taken as an invitation to investors to buy at present price levels, awaiting the materially higher levels which are confidently promised when business again resumes normal conditions. Among the notable advances during the week ending Saturday, June 6, were: Amalgamated Copper, 2⅜; American Telegraph & Cable, 4½; Central Railroad of New Jersey, 5; Denver & Rio Grande, 6; General Electric, 3; New York, New Haven & Hartford, 4½; Southern Pacific, 3⅛, and United States Rubber, first preferred, 2¾. There was little activity shown in the market on Monday, and the fluctuations were within narrow margins. The net changes for the day were mostly records of fractional losses, and at all times the trading was extremely dull. The publication of the government crop report was a sustaining factor, but traders were apathetic. Closing prices on Monday are given in the table.

NEW YORK.

	June 1.	June 8.	Shares Sold.		June 1.	June 8.	Shares Sold.
All.-Ch.	9¼	9⅝	1,000	Int-Met., com..	12¼	11½	6,725
All.-Ch., pfd.	24¾	27⅜	4,000	Int-Met., pfd.	33	32	13,580
Amal. Cop.	67¼	67⅛	130,000	Mackay Cos.	65⅝*	66	100
Am. D. T.	39*	39*	———	Mackay Cos., pfd	65*	65½	200
Am. Loc.	50⅜	49¾	9,200	Met. St. Ry.	27*	30	900
Am. Loc., pfd.	103*	102½	200	N. Y. & N. J. Tel.	110	109	18
Am. Tel. & Cbl.	65	65	100	Steel, com.	38⅞	37⅝	393,270
Am. T. & T.	117¾	118	1,700	Steel, pfd.	102¾	101⅛	23,773
B. R. T.	49¼	48⅝	35,300	W. U. T.	56¾*	50¼	323
Gen. Elec.	138	135½	1,126	West'h, com.	51¼	50¼	4,275
Hud. R. Tel.	—	—	———	West'h, pfd.	70½	—	400

PHILADELPHIA.

	June 1.	June 8.	Shares Sold.		June 1.	June 8.	Shares Sold.
Am. Rys.	44¼	44¼	———				
Elec. Co. of Am.	10	10	———	Phila. Elec.	8½	9½	———
Elec. Stor. B'ty.	30½	33	———	Phila. R. T.	14¾	13⅛	———
E. S. B'ty, pfd.	—	—	———	Phila. Traction	90	87	———

CHICAGO.

	June 1.	June 8.	Shares Sold.		June 1.	June 8.	Shares Sold.
Chicago City Ry.	160	165	———	Met. Elev., Com.	18	18	———
Com. Edison.	94½	95	———	Met. Elev., pfd.	55	53	———
Chicago Subway.	20¾	20	———	National Carbon.	64	67	———
Chicago Tel. Co.	123½	127	———	Nat. Carbon, pfd.	110	112	———

BOSTON.

	June 1.	June 8.	Shares Sold.		June 1.	June 8.	Shares Sold.
Am. Tel. & Tel.	117⅞	117¾	———	Mass. E. R., pfd.	44	47	———
Comb'ind Tel.	—	—	———	Mex. Tel., pfd.	5⅝	—	———
Edison El. Ill.	213	211	———	New Eng. Tel'p.	111½	110¾	———
Gen. Elec.	138	135	———	W'st Tel. & Tel.	6	6	———
Mass. Elec. Ry.	9	10	———	W. T. & T., pfd.	67	—	———

*Last price quoted.
Shares sold are for week June 1-6.

NEW YORK CENTRAL'S TROLLEY HOLDINGS.—Through Mr. Horace C. Andrews, of Cleveland, head of the Andrews syndicate, the New York Central has been gradually acquiring control of New York State traction systems for several years. The full extent of these holdings has now, for the first time, been made known through the movement started by the railroad to secure the consent of the Public Service Commission of the Second District to the formation of an extensive holding company. The new company will be amenable to the public service laws, but, being totally within the state, will be entirely outside the jurisdiction of the Interstate Commerce Commission. The list of properties already acquired is as follows:

	Bonds.	Stocks.
Canandaigua Gaslight		$50,000
Eastern Monroe Electric Light & Gas	$6,000	250,000
Oneida Railway	10,000	15,000
Ontario Light & Trac		30,000
Rochester Ry. & Light	11,926,900	9,500,000
Rochester Electric Ry		200,000
Roch. & Sodus Bay Ry		1,850,000
Rochester Railway	4,557,000	6,000,000
Roch. & East Rapid Ry	1,500,000	1,500,000
Roch. & Suburban Ry	450,000	420,000
Rome City Street Ry	200,000	150,000
Syracuse Rapid T. Ry	4,149,000	4,000,000
Utica & Mo. Val. Ry	3,157,000	7,500,000
Total	$25,955,900	$31,465,000

In addition, it is understood, that options are held on these properties:

	Bonds.	Stocks.
International Traction Company of Buffalo	$18,255,000	$15,000,000
Buf., Lock. & R. Ry	4,000,000	1,760,000
Syracuse & Sub. Ry	550,000	400,000
Total	$22,805,000	$17,160,000

Connection between Rochester and Syracuse may be accomplished by the electrification of the West Shore, or by the purchase of the lines held by the Beebe syndicate, which is the more likely plan. These roads are:

	Bonds.	Stocks.
Roch., Syr. & Eastern	$7,500,000	$8,500,000
Auburn & Syracuse	1,390,000	1,950,000
Auburn & Northern	1,000,000	1,500,000
Total	$9,890,000	$11,950,000

The properties already obtained are held by the Mohawk Valley Company, a corporation with a capital stock of $20,000,000, of which the New York Central holds 60 per cent, while the balance is held by the Central Railway Syndicate, in which are represented the Andrews interests, and to which large owners of New York Central securities are subscribers. The total holding of traction securities by the railroad will, under this plan, amount to about $100,000,000.

DIVIDENDS.—The directors of the Interborough Rapid Transit Company have declared the regular quarterly dividend of 2¼ per cent on the capital stock, payable June 15. Directors of the Chicago City Railway Company have declared the regular quarterly dividend of 1½ per cent, payable June 30. The directors of the Lindsay Light Company, of Chicago, have decided to pass the dividend on the capital stock. Secretary C. M. Wheeler says: "The company was never in better financial condition than it is to-day, but earnings and trade conditions do not warrant the payment of dividends at this time, so the directors have deemed it prudent to defer payment temporarily." The directors of the Columbus Railway & Light Company have declared a dividend of ½ per cent on the capital stock, payable June 15 to stock of record June 1. The directors of the United Traction & Electric Company have declared the regular quarterly dividend of 1¼ per cent, payable July 1. The regular quarterly dividend of 1½ per cent on the capital stock, payable July 10, to stockholders of record June 3, has been declared by the Canadian Westinghouse, Ltd. The West End Street Railway Company, of Boston, has declared a dividend of $2 a share on its preferred stock and 3 per cent on its common stock, payable July 1. Under the terms of the lease with the Boston Elevated, the usual semi-annual dividend of 4 per cent on West End Street Railway Company preferred stock will be paid July 1. The regular quarterly dividend of 2½ per cent, payable June 30, has been declared by the directors of the Chicago Telephone Company.

ANOTHER APPEAL TO WESTINGHOUSE STOCKHOLDERS.—After the meeting of the reorganization committee on June 1, when it was decided to extend to June 22 the time for allowing the stockholders of the Westinghouse Electric & Manufacturing Company to subscribe for their share of the assenting stock, the following letter was sent out to the stockholders: "Your committee reports that the merchandise creditors' committee have succeeded in securing subscriptions to new stock of the company from the holders of all the merchandise debt excepting about $450,000. The advantage to the stockholders of this voluntary conversion into assenting stock, at par, of floating debt of such magnitude is manifest. Unfortunately, the stockholders, the real owners of the property, who have the most at stake, have not done as well as the creditors, for thus far the stockholders have sent in subscriptions for only about one-half of the $6,000,000 of stock for which they are required to subscribe in order that the merchandise creditors' plan may become operative. For the purpose of securing for the stockholders a full opportunity of availing themselves of the subscriptions of the merchandise creditors, and in view of the enormous advantage to the company and its stockholders which would result from the success of the merchandise creditors' plan, the readjustment committee have extended to June 22 the time within which the stockholders may furnish the necessary subscriptions to the new stock. Stockholders who have not yet subscribed should send in their subscriptions at once to the secretary of the committee. It is only by prompt action on the part of the stockholders in subscribing for their full quota of the new stock that a forced sale of the assets of the company and the serious sacrifice of your investment can be prevented." The merchandise creditors' committee is still at work and expect to arrange for the creditors, represented by the $450,000, to take that amount in stock in exchange for their claims before June 22, the final date. The stockholders' committee report that returns are still coming in slowly and express the belief that the necessary amount will be obtained when all the stockholders have been heard from.

DENVER GAS & ELECTRIC.—A stockholders annual meeting of the Denver Gas & Electric Company was held last month, when a report for the year was presented. The net earnings of the company, as shown by the report, were increased $136,012.32. After reading the report the stockholders instructed the directors to create a sinking fund in the general mortgage in order to retire the outstanding bonds of the company from time to time. There are four different methods of sinking fund maintenance under consideration, and one of these will be decided upon at an early date. The stockholders also made arrangements for the issuing of a number of small denomination bonds in place of some of the large denominations now outstanding. At present the smallest bond of the gas company is $1,000. It is planned to take up a number of these and issue their equivalents in denominations of from $100 to $500, in pursuance of the company's policy of interesting as large a number of people as possible in the welfare of the corporation. At present the company has $5,500,000 out in general mortgage bonds, which mature in 1949. The stockholders chose the following men to act as directors for the ensuing year: Emerson McMillan, Henry L. Doherty, Frank W. Frueauff, James B. Grant, John C. Mitchell, Fred G. Moffat, William J. Barker, Henry T. Rogers, Harry C. James, Edward W. Rollins, John T. Brady, John H. Porter, Clare N. Stannard. After the stockholders' meeting had adjourned the directors held a meeting and re-elected officers as follows: Emerson McMillan, chairman of the board of directors; H. L. Doherty, president; Frank W. Frueauff, vice-president and general manager; W. J. Barker, second vice-president and general superintendent; C. N. Stannard, secretary, and John T. Brady, treasurer.

MARCONI OFFICIAL DENIES REORGANIZATION REPORT.—Officials of the Marconi Company deny the report emanating from Washington to the effect that a reorganization of the company is under way and also that the company has given up its fight against the ratification of the Berlin Treaty by the United States. The terms of the treaty, if adopted by the United States, would oblige wireless stations and vessels at sea equipped with wireless apparatus, to communicate with each other without regard to the system used, a move which the Marconi interests have vigorously opposed on the grounds that the government, by the adoption of the treaty, would be interfering with the rights of private enterprise. A director of the company denied that there had been a reorganization. "The company has merely increased its capitalization," he said to the ELECTRICAL WORLD, "to £750,000 by the creation of 250,000 preference shares at £1 each, conferring the right to a fixed cumulative preferential dividend (in priority to all other shares) at the rate of 7 per cent per annum on the capital. Certainly that does not constitute a reorganization. As for the Berlin Treaty, it has been buried in committee in the last session of Congress and we intend to see that it remains buried."

METROPOLITAN STREET RAILWAY CERTIFICATES SOLD.—The Central Trust Company and the banking house of William A. Read & Company bought $3,500,000 of one-year 5 per cent receivers' certificates to be dated June 15, 1908, from Adrian H. Joline and Douglas Robinson, receivers for the Metropolitan Street Railway Company and the New York City Street Railway Company. The certificates are secured by a first lien on all properties and income of these traction companies including real estate and leasehold rights, and upon all property hitherto acquired or to be acquired by the receivers from the proceeds of these certificates. Under the decree of the court no additional certificates can be issued without providing that the proceeds shall be used to take up the $3,500,000 to be issued at the present. The real estate in New York City upon which these certificates will become a first lien includes the power house at the East River and Ninety-sixth Street and other property in various parts of the city, which is assessed at the present time for more than $7,000,000.

COMMONWEALTH (MICHIGAN) POWER COMPANY.—The operating results of the Commonwealth Power Company for the first eight months of the present fiscal year ended Feb. 29, 1908, show gross earnings of $346,551, against $257,424 for the corresponding period last year. Net income, after deducting all operating expenses, taxes, insurance and maintenance charges amounted to $99,134. The 6 per cent dividends on the outstanding $1,252,000 preferred stock amounting to $50,080, leaving a surplus of $49,054 for additional improvements, etc. The company's installation records show that 4,933 motors (aggregating 10,865 hp) in various manufacturing establishments are new served with electric power, compared with 823 motors (representing 7,140 hp) connected last year. To provide for the future, in addition to its seven completed water power properties, this company has acquired many valuable power sites to be developed as needed.

DIRECTORS ELECTED AT MONTPELIER.—The annual meeting of the stockholders of the Consolidated Lighting Company, of Montpelier, Vt., took place on May 25 in New York City. The following directors were elected: Mr. W. F. Davidson, Port Huron, Mich.; Mr. J. C. Tomlinson, New York, N. Y.; Mr. Clarence Senter, Montpelier, Va.; Mr. J. E. Davidson and Mr. C. S. Davidson, both of Montpelier, and Mr. A. D. Bennett, Port Huron, Mich. The following officers were elected: Mr. James E. Davidson, president and general manager; Mr. John C. Tomlinson, vice-president; Mr. A. D. Bennett, treasurer, and Mr. C. S. Davidson, secretary. The same officers were elected for the Vermont Power and Lighting Company and the directors chosen were: Mr. John C. Tomlinson, Mr. A. D. Bennett, Mr. C. S. Davidson, Mr. George G. Moore and Mr. J. E. Davidson. The fiscal year of the two companies ended May 1 and the report of the general manager showed a successful year

CHICAGO RAILWAYS COMPANY SELLS BONDS.—The Chicago Railways Company has sold to N. W. Harris and to the National City Bank an additional $3,000,000 first mortgage 5 per cent bonds. The proceeds will be used at once in order to enable the company to take advantage of the present low prices for construction work, and the bonds will be offered to the public shortly. Following the sale of these bonds the company had placed an order for 650 cars to be delivered not later than April 30, 1909. The price paid for these cars will enable the company to save at least $1,000 on each car, in comparison with prices a year ago, making a total minimum saving of $650,000.

APPLICATION FOR CHICAGO CONSOLIDATED TRACTION RECEIVERSHIP.—In the United States District Court was filed, on Saturday last, an application by the Central Trust Company, of New York, acting as trustee under the mortgage of the Chicago Consolidated Traction Company, for a receiver for the company. The Chicago Consolidated Traction trols all the important suburban electric street railways in the Company was formed in 1899 by Charles T. Yerkes, and connorth and west divisions of Chicago. It is proposed that the receivership shall be used as a basis for reorganization of the company in order to prepare terms on which the property could be sold to the Chicago Railway Company.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

LOCKESBURG, ARK.—The Lockesburg Telephone Company is preparing to construct a telephone line to Paraclifta and Riddle.

NEWPORT, ARK.—The Newport Water, Light & Power Company, recently incorporated with a capital stock of $100,000, has purchased the plant and holdings of the Newport Water Company. The company has been granted a 30-year franchise by the city and proposes to either purchase the local electric light plant or erect a new one. The officers of the company are: A. N. Walker, of Marion, S. C., president; N. V. Walker, of Aurora, Mo., vice-president and general manager; L. Miner, of Newport, secretary and treasurer.

PINE BLUFF, ARK.—The United States Court on June 6 ordered the property of the Pine Bluff Light & Water Company to be sold on June 9 under foreclosure proceedings.

LOS ANGELES, CAL.—The contract for installing a heat and power plant in the new annex to the county jail has been awarded by the County Supervisors to Newell Brothers, of this city, for $10,744.

MONROVIA, CAL.—Application has been made to the City Trustees by H. Kirchenschlager asking for franchises to construct a street railway on the principal thoroughfares in the city, to be operated by electricity, gas or gasoline motor.

SANTA CRUZ, CAL.—The San Vincente Lumber Company contemplates establishing a power plant here. M. H. Grover is manager.

SANTA CRUZ, CAL.—Preliminary steps have been taken for bonding the city for $100,000, for extension of the electric lighting system, water supply and construction of a new bridge.

LAS ANIMAS, COL.—The Navy Department at Washington, D. C., has authorized the award of the contract for installing the electric lighting system at the New Hospital at New Fort Lyon, Las Animas, to the D'Olier Engineering Company, of Philadelphia, Pa., for $8,652.

BETHEL, CONN.—The Danbury Gas & Electric Light Company has submitted a proposition to the borough officials to light the borough with electricity, using tungsten lamps.

HARTFORD, CONN.—Arrangements are being made by the New York, New Haven & Hartford Railroad Company to commence work on the extension of the electric railway to Bloomfield. C. S. Mellen is president of the company.

WASHINGTON, D. C.—Bids will be received until June 16 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards and naval stations the following supplies: Mare Island, Cal.: Schedule 1246—1000 dry battery cells; 12,500 ft. single conductor insulated telephone wire and 6000 ft. rubber covered copper wire; supplies for telephone and telegraph system. Boston, Mass.: Schedule 1270—Four induction motors; switchboard. Bids will also be received until June 23 as follows: Mare Island, Cal.: Schedule 1258—1450 lb. insulating tape; enclosed fuses; copper, copper rod, etc.; lighting wire. Applications for proposals should designate the schedules desired by number. E. B. Rogers, paymaster general, U. S. N.

TAMPA, FLA.—Plans are being considered by the Tampa-Sulphur Springs Traction Company to construct a ¾-mile extension to its system in Ybor City.

ATLANTA, GA.—The Atlanta, Griffin & Macon Railway Company, and the Americus & Albany Electric Railway Company have made application to the State Railroad Commission for permission to issue $5,000,000 in capital stock and $5,000,000 in bonds for each company, the proceeds to be used for the construction of an electric railway from Atlanta to Macon and Albany.

VIDALIA, GA.—The municipal electric light plant has been completed and is now furnishing electricity for lighting the city. The plant was installed by McCrary & Company, of Atlanta.

DWIGHT, ILL.—Seigert Brothers & Company are making arrangements to rebuild and enlarge their electric light plant and have placed orders for a 130-kw, 2200-volt Westinghouse alternator and a four-valve Ball engine.

JOLIET, ILL.—Plans have been completed by the Western United Gas & Electric Company for the construction of its new plant, the site for which has been purchased.

MANITO, ILL.—S. J. Marshall, clerk, writes that the contract for completion of the electric light plant has been awarded to the Ft. Wayne Electric Company for $3,000. E. E. Sayler is engineer.

STREATOR, ILL.—It is reported that the Chicago, Ottawa & Peoria Railway Company will soon commence construction work on its railway between Streator and Ottawa. H. E. Chubbuck, of Ottawa, and George Mattis, of Champaign, are among the directors.

TAYLORVILLE, ILL.—Work will soon commence on the construction of the local railway of the Taylorville Railway Light, Heat & Power Company, which will be about four miles in length. The power station will be located in Taylorville. The company will also sell electricity for lamps and motors. The company is capitalized at $150,000, and the officers are: James Forester, of Taylorville, president; Henry Cheney, of Taylorville, vice-president; James A. Adams, secretary, and W. B. Adams, general manager.

WINDSOR, ILL.—A franchise has been granted by the City Council to the Mattoon, Shelbyville, Pana & Hillsboro Traction Company to construct its railway in Windsor.

CHANDLER, IND.—The Chandler Telephone Company has been granted a franchise to erect a telephone system in this place.

CROWN POINT, IND.—A committee of business men of this place has secured the right of way from Crown Point to Gary, a distance of 11 miles, which it will donate to any company which will build an interurban railway connecting either Gary or Hammond with Crown Point before May 1, 1909. The property is held by three trustees, John Brown, W. G. Woods and W. E. Sasse, who also have a franchise over the highways in Lake County.

INDIANAPOLIS, IND.—Plans are being made by the People's Light & Heat Company to increase its capital stock from $50,000 to $1,000,000, the proceeds of which will be used to construct a large plant in Vigo County, a few miles west of Terre Haute. The company has acquired the coal mines of the Feuvre Coal Company in Vigo County, and proposes to erect its power plant near the mines and erect transmission lines through Terre Haute, Brazil, Greencastle, Danville, Plainfield and to Indianapolis. The plant will have an output of 5000 hp. Frank M. Fauvre is president of the company and Paul H. White, secretary and treasurer.

MARION, IND.—A proposition has been submitted to the City Council by the Marion Light & Heating Company for lighting the streets of the city, which it is said will be considered by the Council.

SOUTH BEND, IND.—The Indiana-Michigan Power Company contemplates rebuilding the Buchanan Dam, which was destroyed by the flood last spring. The present dam will be replaced by a concrete structure.

TERRE HAUTE, IND.—The contract for the construction of the Terre Haute & Merom Traction Company's railway through the town of Gardenville was awarded to Dunn Roberts, of Terre Haute.

MASON CITY, IA.—The name of the Mason City & Clear Lake Traction Company has been changed to the Mason City & Clear Lake Railway Company.

OSKALOOSA, IA.—Plans are being made by the Home Telephone Company to place its wires underground in the business section of the city.

SIOUX FALLS, IA.—F. W. Bisbee, of Castana, is reported to be interested in a project to construct an electric railway from Sioux City to Council Bluffs and Omaha.

SLOAN, IA.—An independent telephone company has been organized by the citizens of Sloan to install a local system. The company is capitalized at $500, and the directors are B. H. Danforth, E. A. Shea and W. B. Backer.

AUGUSTA, KAN.—A local telephone company is being formed by the farmers of Elm Creek to erect a telephone line to connect with the Haverhill Mutual Exchange in Augusta.

CARROLLTON, KY.—The contract for the construction of the new electric light plant has been awarded by the City Council to Samuel Hills, Jr., of Cincinnati, Ohio. The equipment includes a new 250-hp engine, 250-kw dynamo and the construction of a new building at a cost of $19,200.

LEXINGTON, KY.—The Lexington Railway Company has been authorized by the City Council to extend its lines. Louis Des Cognets is vice-president.

MAYFIELD, KY.—It is reported that the Mayfield Water & Light Company will rebuild its power plant which was recently destroyed by fire.

LAKE CHARLES, LA.—The Hi-Mount Land Company has placed a contract with the Lake Charles Ice, Light & Water Works Company for the installation of an electric light system and extension of water mains to Hi-Mount.

FREDERICK, MD.—The Washington, Frederick & Gettysburg Railway Company has awarded the contract for extending its railway from Lewiston to the Monocacy Valley Railroad to J. E. McDonough, of Frederick, Md. A. C. McBride is general manager.

OAKLAND, MD.—The Youghiogheny Light & Power Company contemplates the construction of an electric railway from Oakland to Swallow Falls, with branches to Uniontown, Pa., and Kingwood and another branch to connect with the railroad of the Jennings Lumber & Coal Company. The officers of the company are: A. C. Sturgis, president; Truman West, vice-president; Bowie Johnson, secretary; James D. Hamill, treasurer, and H. P. Tasker, general manager.

ADAMS, MASS.—The citizens of Adams, instead of North Adams (as reported in the issue of May 9), have voted to install an electric light plant at its town farm.

FALL RIVER, MASS.—The new American Thread Mill will be operated entirely by electricity.

LAWRENCE, MASS.—The Pacific Mills will shortly place in operation an electric plant, with an output of 3000 hp, consisting of three Allis-Chalmers turbines. The ultimate output of the plant will be 12,000 hp. The equipment of this plant cost about $69,000 and the wiring $30,000.

LOWELL, MASS.—The Tremont and Suffolk Mills have installed an electric plant, consisting of a 3000-hp Allis-Chalmers turbine, the first of six units.

SPRINGFIELD, MASS.—Plans are being considered for the consolidation of the Berkshire electric railways and the establishment of electric railway connections between Springfield and Pittsfield by connecting the Western Massachusetts and Berkshire systems. The Legislature will be asked to pass a bill giving the Berkshire company permission to construct a railway to connect the system with the summit of Greylock Mountain, extend its railway south from Great Barrington through the town of Sheffield to the Connecticut line and connect this extension with the town of Egremont. The plan involves an expenditure of $2,000,000. The financing will be done by the New York, New Haven & Hartford Railroad Company, which operates the railways.

BENTON HARBOR, MICH.—The contract for the construction of the Chicago, Benton Harbor & Grand Rapids Electric Railroad has been awarded to Charles A. Applegate, of Chicago, Ill.

KALAMAZOO, MICH.—The plant of the Commonwealth Power Company was badly damaged by fire May 28, putting the lighting and street car service in the city out of commission. Two large transformers were damaged.

PALMER, MICH.—The question of extending its system to Princeton is being considered by the Marquette County Telephone Company.

BRAINARD, MINN.—Plans and specifications have been prepared by George Cadogan Morgan, 69 Jackson Boulevard, Chicago, Ill., for the construction of an electric light plant and water works system for the city. Estimates were submitted on hydro-electric, gas, oil and steam power plants as follows: Generating plant on Crow River, pole line, pumping equipment, etc., $146,327; gas plant, etc. (complete), $65,677; American Diesel oil engine plant, etc. (complete), $69,857; steam plant, complete, $36,107. The hydro-electric plant would, with the addition of more machinery, give the city over double the amount of power available from other sources at an additional cost of $18,975. The City Council has retained Mr. Morgan as consulting engineer to have charge of the work.

MINNEAPOLIS, MINN.—The Minnesota Construction Company has been organized to build an electric railway from Minneapolis to Medicine Lake, which later will be extended to Montevideo. Right of way has been secured for the first section, which will be six miles in length. The company is capitalized at $100,000, and the officers are: John Blichfeldt, president; W. W. Wardwell, secretary and treasurer.

THIEF RIVER FALLS, MINN.—The Farmers' Telephone Company is contemplating the construction of a telephone line from Sanders to Thief River Falls in the near future.

CARROLLTON, MISS.—W. H. Hafner, mayor, writes that bids will be received until June 15 for rebuilding the electric light plant. R. C. Huston, of New Orleans, La., is engineer.

ST. LOUIS, MO.—Plans are being considered by the Affiliated Business Men's Association to erect and maintain a municipal electric lighting plant, the cost of which is estimated at $3,000,000. For further information address Leo A. Landan, chairman of the Legislative Committee.

UNIVERSITY CITY, MO.—Plans are being considered to make extensive improvements to the town, including the construction of a municipal electric light plant, city hall, park, etc., the cost of which is estimated at about $250,000. It is proposed to issue $100,000 in bonds at once to commence the work and to issue the remainder in January, 1909.

MILES CITY, MONT.—The City Council has voted to issue $10,000 in bonds, the proceeds to be used to enlarge the municipal electric light plant.

TOWNSEND, MONT.—Plans are being made by the Delp Creek Improvement Company for the construction of an electric light plant, bids for which will probably be received about Aug. 1. The company has a 25-year franchise and proposes to build a 100-hp plant and furnish electricity for lighting the town of Townsend, and a plant of 500 hp to supply electricity for mines at Radersburn. N. S. Poole is general manager, and C. Helmick, of Helena, engineer.

PENDER, NEB.—The citizens are considering the question of holding an election to vote on the proposition of issuing bonds to establish a municipal electric light plant.

UNIVERSITY PLACE, NEB.—F. Harbican, superintendent of the municipal water and light plant, writes that the city is in the market for three electrically driven pumps. The city has entered into a contract with the Lincoln Traction Company to furnish electricity to operate the municipal electric light system and to pump the city water for a term of five years at the rate of 4 cents per kw-hour delivered at the University Place station.

ATLANTIC HIGHLANDS, N. J.—The Borough Council has granted the New Jersey Traction Company a franchise to lay its tracks through the business section of the town.

JERSEY CITY, N. J.—The Board of Aldermen on May 26 granted a franchise to the Mutual Benefit Electric Light & Power Company to construct and operate an electric light plant in this city, in return for which the company is to pay the city 5 per cent of its gross receipts. The company proposes to install a modern plant and place all its wires underground. It also agrees to furnish electricity for lamps at the rate of 8 cents per kw-hour, with a discount of 5 per cent on all bills paid within five days after presentation.

PASSAIC, N. J.—At the special election held June 2 the citizens voted in favor of installing a municipal electric light plant.

PATERSON, N. J.—Plans are being considered for the construction of an electric railway from Paterson to New Foundland.

PATERSON, N. J.—Plans are being made to incorporate the North Jersey Transit Company for the purpose of operating an electric railway between Paterson and Suffern, a distance of 15 miles. The company will be capitalized at $1,000,000.

ALBUQUERQUE, N. M.—D. K. B. Sellers is reported to be interested in a project to build an electric railway on the Highlands.

ALBION, N. Y.—The A. L. Swett Electric Light & Power Company, of Medina, has applied to the Public Service Commission for permission to extend its service to this village, for which a franchise has already been granted by the town.

BINGHAMTON, N. Y.—The Binghamton Railway Company contemplates extending its railway system to Owego and Waverly.

BUFFALO, N. Y.—The Board of Aldermen has authorized the Commissioner of Public Works to secure a new contract for electricity to operate the electric pumps at the water works station. The present contract expires June 30, 1908.

MIDDLEBURGH, N. Y.—Plans are being considered by the Middleburgh Telephone Company to place cables on Main Street and Railroad Avenue in this city.

ROCKVILLE CENTER, N. Y.—The South Shore Traction Company has been granted a franchise by the Village Trustees to construct and maintain an electric railway in the town.

SYRACUSE, N. Y.—Bids will soon be asked by the Board of Contract and Supply for lighting the streets and municipal buildings of the city.

POORS KNOB, N. C.—The W. C. Meares Mill Company has secured a charter to develop water power, to generate electricity and to erect mills. The capital stock of the company is placed at $12,000. R. L. Doughton is interested in the project.

TARBORO, N. C.—The Carolina Telephone & Telegraph Company is planning extensive extensions to all of its lines in the state. The capital stock of the company was recently increased from $250,000 to $300,000.

WILSON, N. C.—The Tar River Light & Power Company has amended its charter increasing its capital stock to $100,000.

CLEVELAND, OHIO.—Plans are being considered by the Cuyahoga Light, Heat & Power Company to utilize the water power of the Cuyahoga River at Cuyahoga Falls.

LOGAN, OHIO.—D. V. Thurness, mayor, writes that the village is considering the construction of a municipal electric light plant, the cost of which is estimated at about $15,000. A. G. Hall, of Logan, electrical engineer, will have charge of the work.

ARDMORE, OKLA.—J. D. Connelly, of Titusville, Pa., and E. A. Rea, of Corydon, Ia., are interested in a project to build a street railway system in Ardmore.

GUTHRIE, OKLA.—The Oklahoma Gas & Electric Company contemplates making improvements to its system, which will involve an expenditure of about $200,000.

ASTORIA, ORE.—Preliminary steps have been taken to organize the Astoria, Seaside & Tillamook Railroad Company for the purpose of building an electric railway from Astoria to Seaside and thence to Tillamook. The company will be capitalized at $2,000,000. F. L. Evans is promoter of the company.

DIXONVILLE, ORE.—Arrangements are being made by the North Deer Creek Telephone Company to erect a telephone line from Rosenburg to Dixonville. E. A. Hinkel is president of the company and Homer H. Fox, secretary.

PORTLAND, ORE.—The county court has granted to the United Railways two franchises.

PORTLAND, ORE.—The Portland Railway, Light & Power Company has applied to the City Council for a blanket franchise granting the company permission to lay tracks on different streets of the city. The cost of the work is estimated at $250,000.

SALEM, ORE.—The Salem-Fairfield Telephone Company has been granted a franchise to erect a telephone line between Salem and Champoeg.

PANAMA.—Bids will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until June 29 for furnishing copper tubes, electrical fixtures, wire, incandescent lamps, etc. Blanks and general information relating to this circular (No. 446) may be obtained at the above office or at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; Custom House, New Orleans, La.; 1086 North Point Street, San Francisco, Cal., and the Chamber of Commerce, Tacoma, Wash.; also from the U. S. engineer offices in the following cities: Los Angeles, Cal.; Baltimore, Md.; Philadelphia, Pa.; Pittsburg, Pa.; Boston, Mass.; Buffalo, N. Y.; Cleveland, Ohio; Cincinnati, Ohio; Chicago, Ill.; St. Louis, Mo.; Detroit, Mich.; Milwaukee, Wis.; St. Paul, Minn.; Chattanooga, Tenn.;

Louisville, Ky., and Mobile, Ala. Lieut.-Col. H. F. Hodges is general purchasing officer.

AVOCA, PA.—The Borough of Avoca has renewed the contract for street lighting with the Standard Electric Light Company for a term of five years from June 1, 1908. Under the terms of the contract the company is to furnish arc lamps at the rate of $65 per lamp per year. Frank Howard is superintendent of the Standard Electric Light Company.

HUNTINGDON, PA.—The Juniata Water & Power Company, which is operating a power plant in Warrior Ridge Gap, is contemplating making extensive additions to its system and extending its transmission lines through the Juniata Valley. Plans have been completed for the second hydro-electric plant along the Juniata River, which will be located between Huntingdon and Lewiston. The company will soon commence work on the erection of the extension of the steel tower transmission system from the Warrior Ridge plant through Huntingdon to Lewiston. In addition to the second dam and the extensions of the transmission line, three hydro-electric plants will be erected along the Juniata River, all of which will supply electrical energy through the main transmission line. The company now furnishes electricity for lamps and motors in Huntingdon, Tyrone and Altoona. S. L. Brumbaugh is interested in the project.

JOHNSTOWN, PA.—The Johnstown Telephone Company contemplates extending its system to St. Michael.

NEW CASTLE, PA.—Plans are being considered to install a power plant in the high school to furnish electricity for lighting the building, also for heating and ventilating.

NORRISTOWN, PA.—Plans are being considered by the American Union Telephone Company to extend its service into the surrounding country.

WOONSOCKET, R. I.—The Woonsocket Electric Machine & Power Company has made arrangements with the Hamlet Textile Company for the purchase of additional power. The company is using about 75 hp furnished by the Hamlet Textile Company.

ABBEVILLE, S. C.—The citizens on June 3 voted in favor of the proposition to issue $25,000 in bonds to purchase and rebuild the electric plant of the Abbeville Light & Power Company.

FOUNTAIN INN, S. C.—Contracts have been placed by the Fountain Inn Manufacturing Company for the construction of its additional mill building, cottages, etc., at Fountain Inn. The machinery of the new mill will be operated by electricity, which will be furnished from the power plant of the Enoree Power Company, seven miles distant.

MITCHELL, S. D.—The electric light and gas plant of the Mitchell Gas Company has been purchased by the Mitchell Power Company. The new owners contemplate enlarging and improving the plant.

MEMPHIS, TENN.—Sealed proposals will be received by the Shelby County Courthouse Commissioners until July 1 for furniture and furnishing interior work, including electric and gaslight fixtures and electric time clock system for the new courthouse building for Shelby County. Plans and specifications may be seen at the office of Hale & Rogers, 11 East Twenty-fourth Street, New York, N. Y., architects, or at the office of the architects' superintendent, or at the office of the Shelby County Commissioners, Memphis, Tenn. John Colbert is secretary of the commission.

TREZEVANT, TENN.—The Trezevant Telephone Company has decided to construct a long-distance line from this city to Bradford, by the way of Holly Leaf.

AMARILLO, TEX.—The Panhandle Telegraph & Telephone Company will place its wires underground in the business portion of the city.

AUSTIN, TEX.—The Water, Light and Power Committee has engaged Walter G. Kirkpatrick, of Jackson, Miss., to prepare plans for rebuilding the Austin Dam, which was partly carried away during a flood in the Colorado River in April, 1900, and a large part of the power house and equipment was wrecked. It is proposed to rebuild the dam and equip the power house.

EL PASO, TEX.—The capital stock of the El Paso Electric Railway Company has been increased from $750,000 to $1,500,000.

FORT WORTH, TEX.—The Northern Texas Traction Company has filed amendments to its charter increasing its capital stock from $250,000 to $3,000,000.

NAVASOTA, TEX.—The Navasota Light & Power Company has been incorporated, with a capital stock of $20,000, by R. A. Horlock, W. R. Horlock and E. A. Harris.

ROCKPORT, TEX.—The Rockport Ice & Light Company has placed a contract with Turner & Prior, electrical engineers, for the installation of a new electric light plant in Rockport.

RICHMOND, VA.—The City Council has passed an ordinance providing for an issue of $350,000 in bonds, the proceeds to be used for the construction of an electric light plant on the site of the old pumping plant.

COLVILLE, WASH.—The W. H. Gerhart-Bradrick Lumber Company has received a proposition from the Northwestern Gas & Electric Company offering a special rate for electrical power for elevating lumber from the lumber company's yard to the top of thte hill, also to furnish energy to operate the new planing mill and box factory soon to be erected.

ELLENSBURG, WASH.—An independent telephone company has been organized by the farmers of the Reecer Creek District for the purpose of erecting a telephone line to connect that section of the country with the main line in Ellensburg.

NEWPORT, WASH.—R. S. Anderson, who recently purchased the local exchange of the Pacific States Telephone & Telegraph Company, has been granted a franchise in this city. The system is to be reconstructed and a telephone line built to Metaline. The cost of the work is estimated at $10,000.

NORTH YAKIMA, WASH.—The North Yakima & East Selah Irrigation Company is asking for bids for the construction of a large power canal to develop 3400 hp and to utilize the full minimum flow of the Yakima River, work on which will commence this summer. Smith & Young are the engineers.

SUMAS, WASH.—An independent telephone company has been formed by a number of residents of Upper Sumas, Abbotsford and Huntingdon for the purpose of constructing lines into the towns of Sumas and Matsqui to make connections with Chilliwack and other cities. L. G. Van Valkenburg is interested in the project.

WALLA WALLA, WASH.—The Walla Walla Valley Traction Company has applied to the County Commissioners for a franchise.

WESTON, W. VA.—J. S. Mitchell, superintendent of the Weston Electric Light, Power & Water Company, writes that the company is planning to enlarge its plant and will install a 300-hp water-tube boiler this summer and renew the pole line.

WHEELING, W. VA.—The Wheeling Traction Company is contemplating extending its railway to Moundsville this summer. As yet nothing definite has been decided upon.

APPLETON, WIS.—The Wisconsin Traction, Light, Heat & Power Company is contemplating extending the local street railway. The extension will comprise about two miles of track.

APPLETON, WIS.—The Green Bay & Mississippi Canal Company, which is constructing an electric power plant at Kaukauna, is making arrangements to build a new dam, below the plant now under construction, where a head of 27 ft. will be secured to furnish power for another large electric plant which the company will construct. It is said that the company will lease the first plant as soon as it is completed. During the summer the plant of the Appleton Paper & Pulp Company, which is owned by practically the same interests as the Green Bay & Mississippi Canal Company, will be torn down and an electric power plant erected on the site, which will be leased immediately to the local companies to furnish electrical energy for their factories.

JEFFERSON, WIS.—The citizens have voted in favor of the proposition to issue $7,500 in bonds, the proceeds to be used for improving the municipal electric light plant.

MILWAUKEE, WIS.—Plans are being considered by the committee on street lighting of the Greater Milwaukee Association and the Council committee for improving the street lighting system in the business section of the city.

SPARTA, WIS.—Work has commenced on the construction of the proposed railway of the Sparta & Melrose Electric Railway & Power Company from Sparta to Melrose, a distance of 28 miles. The officers of the company are: Charles Newland, president; James Cole, vice-president; Howard Teasdale, secretary, and W. A. Sholes, treasurer.

STEVENS POINT, WIS.—The Porter Telephone Company, which is building a telephone line through Plover and Stockton to Stevens Point, is planning to build other lines west and north of Plover.

CHEYENNE, WYO.—The City Council has passed an ordinance granting a franchise to T. H. Cosgriff and others, of this city, to construct and operate an electric street railway and to generate and distribute electricity for lamps and motors in Cheyenne.

LETHBRIDGE, ALB., CAN.—The City Council has received the report of Cecil B. Smith, power expert, which recommends the city retaining control of the power plant and also the making of several improvements.

NELSON, B. C., CAN.—The City Council has made an offer to supply electrical power free to the Nelson Tramway Company if the company will at once resume the street car service in force before the power plant was destroyed by fire.

VANCOUVER, B. C., CAN.—Plans are being made by E. K. Rogers to erect a $40,000 power plant in connection with the Hidden Creek group of mines at Goose Bay, Observatory Inlet. The plant will be installed this summer.

VICTORIA, B. C., CAN.—The Provincial Government has approved the plans of the Prince Rupert Power & Light Company, of Prince Rupert. The company is authorized to construct its system, including dam, pipe lines and power houses at or near Woodworth Lake, Shoowahtlans River, in the Skeena River mining division, and to transmit and distribute electricity to various points on the Tsimpsean Peninsula, and Kaien and Digby Islands.

HAMIOTA, MAN., CAN.—The municipality of Hamiota has decided to build a rural telephone system. For further information address Joseph Andrews.

WINNIPEG, MAN., CAN.—The Winnipeg Electric Street Railroad Company has decided to extend its road through the municipality of St. Vital. Wilford Phillips is general manager.

WINNIPEG, MAN., CAN.—The City Council has decided to sell $600,000 in bonds for the construction of the plant now being built at Lac du Bonnet at a cost of approximately $3,000,000. Cecil B. Smith is civic power expert.

KINGSTON, ONT., CAN.—The Kingston Milling Company has secured a site about six miles east of Kingston, where it will erect a power plant and will transmit electricity to its mill, which will be enlarged.

NORTH BAY, ONT., CAN.—The Town Council has made application to the Hydro-Electric Commission to develop Smoky Falls, on the Sturgeon River, 18 miles distant, to furnish North Bay with electricity.

PORT ARTHUR, ONT., CAN.—C. B. Smith, of Toronto, consulting engineer, has been authorized to prepare plans, to be submitted to the Council, for the development of 10,000 hp at Dog Lake Falls.

PORT ARTHUR, ONT., CAN.—The Electric Railway Commissioners have been authorized to proceed with the double tracking of the Port Arthur Electric Railway system between Current River Park and the southern boundary of the city. The railway is owned and operated by the city.

PORT ARTHUR, ONT., CAN.—The City Council has decided to carry out the recommendations of Cecil B. Smith, civic power expert, in regard to the development of power along the Current River. The damage to the plant by the recent flood will also be repaired. For further information address J. J. Carrick.

PORT ARTHUR, ONT., CAN.—The recent fire at the plant of the Port Arthur Electric Light & Power Company destroyed seven dynamos, 16 transformers, tools, etc., leaving intact only the walls of the building, two steel penstocks and two water wheels, with shafting. The loss is estimated at about $35,000. New generators, shafting and other equipment were installed and a new roof put on the building and the plant put in operation and electricity furnished to the towns for lamps and motors 17 days after the fire.

TORONTO, ONT., CAN.—Bids will be received by Adam Beck, chairman of the Hydro-Electric Power Commission, Toronto, until July 15 (extension of time from June 2), for the construction of the Toronto-Niagara Falls, St. Thomas-Niagara Falls transmission line; steel transmission towers; transmission line cable, and erection complete of transmission system, according to plans and specifications to be seen at the Commission's office. Tenders will not be considered unless on form supplied by the Commission.

TORONTO, ONT., CAN.—The Board of Control has decided to construct the municipal electrical distributing plant by city labor, and to establish an electrical construction department, with a consulting board of three experts, and an engineer of construction under this board. Alexander Dow, of Detroit, Mich., was appointed one of the members of the board and has been asked to appoint the two other members. The engineer to have charge of the construction work will be appointed by the City Council.

New Industrial Companies.

THE PORTSMOUTH ELECTRICAL & PLUMBING COMPANY, of Portsmouth, Ohio, has been incorporated, with a capital stock of $12,500, by Charles Barlow, W. L. Reed, G. J. Schmidt, H. W. Hier and W. R. Sprague.

THE ELECTRICAL TRADING COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $1,000, and the following directors: Edward McAviney, Jason G. Lamison and Timothy A. Leary.

THE AMERICAN INSULATING COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $12,000, to manufacture insulating materials.

THE TROY TELEPHONE SPECIALTY COMPANY, of Troy, N. Y., has been incorporated, with a capital stock of $15,000, to manufacture telephone appliances and instruments. The incorporators are: Perry J. Fitzgerald, of Albany; Edward L. Granel and Joseph F. McLaughlin, of Troy.

THE PRESSED STEEL TURBINE ENGINE COMPANY OF AMERICA, of Kittery, Maine, has been incorporated, with a capital stock of $2,000,000. The officers of the company are: W. C. Cogswell, of Newton, Mass., president; C. D. Wainwright, Jr., Marblehead, Mass., treasurer, and H. Mitchell, of Marblehead, Mass., clerk.

New Incorporations.

GRIDLEY, CAL.—Plans have been completed by Ralph Beebe, engineer, for a combined municipal water and light plant.

COLORADO SPRINGS, COL.—The Kansas-Colorado Railway Company, capitalized at $5,000,000, and the Colorado Transportation Company, with a capital stock of $5,000,000, have been organized to construct an electric railway from Garden City, Kan., up the Arkansas Valley to Canon City, Colorado Springs and Denver. The companies will furnish electricity and water to towns along the route. The incorporators of both companies are: A. H. Atwater, of Canon City, Col.; J. A. Lockhart, of Rocky Ford, Col.; R. W. Paterson, of La Junta, Col., and A. H. Warner and Andrew Russell, of Garden City, Kan.

LA JUNTA, COL.—The Kansas-Colorado Electric Transmission Company has been organized, with a capital stock of $3,500,000. The company will be operated in connection with the Kansas-Colorado Railway Company, which has been incorporated with a capital stock of $5,000,000. The officers of the two companies are: S. H. Atwater, of Canon City, president; J. A. Lockhart, Rocky Ford, vice-president; Robert W. Patterson, of La Junta, second vice-president; A. H. Warner, of Garden City, secretary, and Andrew Russell, of Dodge City, Kan., treasurer.

TWIN FALLS, IDAHO.—Articles of incorporation have been filed for the Idaho & Nevada Southern Railway Company to construct an electric railway from Twin Falls and other points on the Twin Falls tract to Wells, Nev. The capital stock of the company is placed at $250,000, and the officers are: H. L. Hollister, president; I. B. Perrine, vice-president and general manager, and R. M. McCullom, secretary and treasurer.

CHARLESTOWN, ILL.—The Charlestown, Westfield, Marshall & Terre Haute Railway Company has been incorporated with a capital stock of $50,000. The officers of the company are: W. R. Patton, of Charleston, president; J. W. Dawson, of Westfield, vice-president; Seymour Hurst, of Marshall, secretary.

MILFORD, ILL.—The Milford Telephone Company has been incorporated, with a capital stock of $25,000, by C. H. Dawson, A. J. Hall, M. F. Dawson and others.

Legal.

ELECTRIC PLANT IN RECEIVERS' HANDS.—The Arcadia Electric Light Company, of Arcadia, has been placed in the hands of G. P. Wing and A. E. Shaffer, as receivers. The plant is owned by John A. Shunk, of Peru, and on account of the company's failure to pay interest on its mortgage indebteness it was placed in the hands of receivers.

FULTON POWER COMPANY CLAIMS DAMAGES.—The Fulton Light, Heat & Power Company, of Fulton, N. Y., has filed in the Court of Claims a claim against the state for the appropriation of land and water power on the Oswego River at Fulton, which the company claims to own and which was taken by the state in connection with the barge canal project. The company claims damages to the amount of $5,200,000. The Court of Claims will hold a special session in New York, N. Y., June 22, to hear the testimony on the claim. The state claims to own the water and the right to take it for canal purposes without compensation.

ROANOKE WATER COMPANY ENJOINED.—An injunction was granted in the corporation court in the case of the Virginian Railway Company v. the Roanoke Water Power Company, of Roanoke, Va., by which the latter is restrained from raising the dam of its electric plant 2 ft. The plant is located on the Virginian, and it is stated that a contract between the two companies specified that the dam should not be more than 45 ft. in height, otherwise a portion of the track would be flooded. The power company recently made a contract to supply the railway company with electricity for lamps and, desiring as much reserve power as possible, planned to raise the dam.

RIGHTS OF EMINENT DOMAIN DENIED BY THE COURT.—An action instituted some time ago by the Yadkin Power Company, chartered by the State Legislature to operate power plants on the Yadkin River, to secure the right to condemn the lines of the Whitney Company, has been disposed of in the state courts in favor of the Whitney Company, of Salisbury, N. C. The Yadkin company alleged that it possessed the right of eminent domain and had secured electrical rights on the river prior to the time of the establishment of the Whitney company's undertaking near Salisbury, N. C. The Yadkin Power Company has now taken an appeal to the state Superior Court.

Personal.

DR. H. T. BOVEY, Rector of the Imperial College of Science and Technology, London, will deliver the address on June 12 at the commencement of Clarkson Memorial School, Potsdam, N. Y.

MR. WILLIAM W. COLE, for many years manager of the Elmira Water, Light & Railroad Company, of Elmira, N. Y., has resigned from that company and after July 20 will be associated with the firm of Dodge & Day, modernizing engineers of Philadelphia, in which firm he has taken an interest.

MR. REGINALD PORTER, a director of the Key Engineering Company, of London, has spent the past month in this country in the study of electrical work and of large gas engines, and sailed for home on June 6 on the Cunarder *Campania*. Mr. Porter is to present a paper on the gas engine topic before one of the engineering societies in England at an early date. He attended the National Electric Light convention at Chicago, and visited Pittsburg, Milwaukee, Buffalo, Niagara, Montreal and Boston.

MR. HUGH MILLER, a prominent member of the Glasgow City Council, has been visiting this country, and making a study of lighting development, which is under his special attention in the Council. On Friday evening, June 5, Mr. Miller, who sailed the next day on the *Columbia*, was a guest at the Engineers' Club at a farewell dinner given in his honor. Those present were Commissioner Milo R. Maltbie, of the Public Service Commission; President Alex. C. Humphreys, of the Stevens Institute of Technology; Mr. H. G. Stott, President American Institute of Electrical Engineers; Messrs. J. W. Lieb, Jr., and Arthur Williams, of the New York Edison Company; Messrs. R. A. Carter and W. R. Addicks, vice-presidents, and Mr. W. H. Bradley, chief engineer, Consolidated Gas Company, and Mr. T. C. Martin. After dinner a very thorough inspection was made of the Engineering Societies' Building, particularly the headquarters of the National Electric Light Association, the Gas Institute, and the Association of Edison Illuminating Companies, all of which were thrown open for the occasion and which interested Mr. Miller deeply.

MR. ALLISON J. THOMPSON, lately of Cleveland, Ohio, has joined the Excello Arc Lamp Company as secretary and general manager.

MR. THOMAS L. HARTIGAN, president of the Manila Electric Railroad & Light Company, of Manila, P. I., has returned to the United States. He will spend the summer here and return to Manila in the fall.

MR. R. L. BRITTIAN has resigned as superintendent of the Northfield Lighting & Power Company, of Northfield, Vt., to accept a position as superintendent of new electric plant owned by Moody & Almon, in Montpelier, Vt., now in process of construction. Mr. Brittian will take charge July 1.

MAJOR E. L. ZALINSKI, U. S. A., now on the retired list, has recently been installed as president of the Bureau of Illuminating Engineering, Incorporated, at 437 Fifth Avenue, New York. This bureau will consider questions involving the conditions requisite for suitable and proper illumination.

MR. H. M. HIRSCHBERG, president of the Excello Arc Lamp Company, sailed on the steamer *Celtic*, June 4, accompanied by Mrs. Hirschberg, for his annual visit to the works in Germany. Mr. Hirschberg will be absent about five weeks and will visit other important electrical factories in Europe.

MR. JAMES S. WATSON, manager of the drive chain department of the Link-Belt Company, has transferred his headquarters from the Philadelphia works to the company's chain manufacturing plant at Indianapolis. In his new field he will combine supervision of manufacture with direction of the selling force handling the Renold silent and roller chains.

MR. R. A. PHILLIP, of Stone & Webster, Boston, has completed a course of lectures to senior students at Massachusetts Institute of Technology on modern switching practice with high-tension circuits. Mr. A. S. Michener, comptroller of the Stone & Webster organization, lectured on the theory of accounting and the relations of the engineering, operating and executive departments to the accounting department, and Mr. Walter Goodenough of the same organization lectured on boiler-room practice.

MR. A. J. J. PFEIFFER, the general manager of the Calcutta Tramways, is in this country on a short trip, and proposes also to visit Mexico. Mr. Pfeiffer was formerly connected with the General Electric Company and went abroad in 1897 to make important railway installations for the French Thomson-Houston Company. Among the roads constructed under his direction was the Milan-Gallarate-Porte Ceresio third-rail line to the Italian lakes. In 1902 Mr. Pfeiffer became associated with Dick, Kerr & Company, of England, and soon after went to Calcutta, India, in the interests of that company to install the system of which he then became general manager.

MR. J. R. McCOLL, formerly associate professor of steam engineering at Purdue University, Lafayette, Ind., and now connected with the engineering department of the American Blower Company, Detroit, has been delivering a series of lectures before engineering classes of the technical schools in the Middle West. The subjects dealt with are the movement and heating of air for heating, ventilating and drying systems, the theory and practice of blower design and installation and kindred topics. The lectures are illustrated by means of stereopticon views and are followed by discussions on the part of the students, who invariably evince great interest in the subjects presented.

PROF. A. L. WALKER has been appointed professor of metallurgy and administrative head of the Department of Metallurgy, at Columbia University, New York City. His duties will begin on July 1 and he will take personal direction of the instruction in non-ferrous and electrometallurgy and metallurgical design. Professor Howe will continue to deliver his lectures on iron and steel. Mr. Walker has had an exceptionally valuable practical experience in all branches of metallurgical work since his graduation from Columbia. He was born on Jan. 14, 1863, and received his preparatory school education at Charlier Institute, New York City, and Morris Academy, Morristown, N. J. He was graduated from the School of Mines of Columbia University in 1883 with the degree of E. M.

Obituary.

MR. WILLIAM HAMMOND HUBBARD, who assisted Dr. Alexander Graham Bell in the late '70s in the development of the telephone died June 1, at Lake Forest Ill. Mr. Hubbard was 50 years old.

SIR ROBERT G. REID, who died in Montreal on June 3, was an engineer of international fame. He built many of the noted railroad bridges in this country, but his most important work was the development of Newfoundland, which began in 1890. Since that time, through grants and concessions, his power on the island became enormous, and he built and controlled the railways and larger public utilities. At one time he contracted with the government to operate the whole of the telegraph lines of the island and maintain and operate an electric street railway in St. John's. These two monopolies did not meet with public approval, however, and he turned his telegraph holdings over to a company with $25,000,000 capital, and agreed to the reversion of the railroads to the government at the end of 50 years. In 1907 he was knighted for his services to Newfoundland, of which he had been called the greatest benefactor.

Unclassified Items.

(Items received too late to classify under Construction News, etc.)

WASHINGTON, IND.—The sale of the municipal water works plant by the receiver was set aside by the court on the ground of irregularity. The property will be sold at a future receiver's sale.

DELPHI, IND.—The Carroll Electric Light Company has filed articles of incorporation with the Secretary of State with a capital stock of $10,000. The object of the corporation is to build and operate an electric light plant for the purpose of generating electricity for light, heat and power in Delphi and other towns and villages in said county. John H. Burr, Nathaniel Moore, A. V. Smith and F. C. Smith are the directors.

WAHOO, NEB.—Bids will be received by the city until June 25 for the construction of a municipal electric light plant and water works system, the cost of which is estimated at $60,000. John Martz, of Wahoo, is engineer.

BRUCE, WIS.—Bids will be received until June 23 by the village of Bruce for the construction of an electric light plant and water works system. Oscar Claussen is consulting engineer.

LISTOWEL, ONT., CAN.—The town of Listowel will receive bids until June 18 for complete equipment for an electric lighting plant with an output of about 200 hp, consisting of gas producers and engines, boilers and steam apparatus, generators, switchboards, transmission supplies, etc. For further information apply to K. L. Aitken, 1003 Traders Bank, Toronto, consulting engineer.

HARRISBURG, PA.—Governor Stuart has approved the following extensions of electric railways: The West Penn Interurban Railway Company from near Poundstone Ferry to New Geneva, four miles; also from near Republic Works to Dearth post office and beyond, a distance of 7½ miles. The Brownsville Street Railway Company over certain highways in Bridgeport, a distance of 3½ miles.

GREEN BAY, WIS.—The Northern Hydro Electric Power Company has been incorporated for the purpose of developing the water power at High Falls and Johnson Falls to generate electricity. B. L. Parker, of Green Bay, is secretary.

EUREKA SPRINGS, ARK.—At the annual meeting of the Citizens' Electric Company the following named officers were elected: J. D. Jordan, president; M. D. Jordan, vice-president; C. C. McCarty, secretary and treasurer.

VICTOR, MONT.—J. S. Hodge has secured a site for an electric light plant and will develop a water power.

BLOOMINGTON, ILL.—The Union Gas & Electric Company has been reorganized and the following officers elected: Richard S. Storrs, president; G. Bullock, vice-president; L. B. Johns, secretary and treasurer. W. F. Clausen will be retained as superintendent, and L. B. Johns will have charge of the new business section. Extensive improvements are contemplated to the system later on.

KANSAS CITY, MO.—The Denton, Foote & Company, of Kansas City, is reported to have secured the contract for equipping what is known as the "Strang" line to be operated by electricity from the Missouri & Kansas Interurban Railway Company.

HUDSON, N. Y.—The Albany & Hudson Railroad Company has purchased what was known as the Rider electric light plant of Frank B. Erwin, of New York City, and has taken possession of the entire outfit, which includes poles and wires, engine, generator and all the machinery in the old pumping station. It is expected that the machinery, all of which is new, will be sold. The Albany & Hudson Railroad Company has made a number of improvements to its power plant at Stuyvesant Falls, including the installation of a new engine, to provide additional power to operate its system.

MALDEN, MASS.—The Street and Water Commission has recommended that it be given permission to make a three-year contract with the Malden Electric Company to light the streets of the town under the same conditions and prices as under the present contract, but to replace the present incandescent street lamps with the new tungsten lamp.

COWLEY, WYO.—B. E. Slusser is interested in a project to construct an electric plant to provide Lowell, Crowley and Byron with electricity for lamps and motors. It is proposed to erect a plant on the Shoshone River between the towns and to develop the water power of the river to operate the plant.

LA GRANDE, ORE.—The Grande Ronde Electric Company contemplates utilizing the water power of Olive Lake instead of installing a steam power plant to provide additional power for its system. The cost of the improvements contemplated is estimated at $45,000.

NIAGARA FALLS, N. Y.—The contract for the extra illumination of Falls Street has been awarded by the merchants who have subscribed to the project. The cost will be $2,500, which will provide for 1000 16 cp incandescent lamps placed on 14 arches.

WHITE RIVER JUNCTION, VT.—The Mascoma Electric Light & Gas Company is installing new machinery at its new power plant on the Glen Road in West Lebanon, N. H.

BOSTON, MASS.—Lieut.-Governor Draper has signed the bill for the incorporation of the French King Rapids Power Company with authority to construct a dam across the Connecticut River and to furnish electricity for light and power.

TAMAQUA, PA.—At a meeting of the Tamaqua Light, Heat & Power Company held on June 3, the following officers were elected: Jas. Tinley, president; George Kellner, treasurer; David Bensiger, secretary; A. C. Shuttleworth, general manager. The company also voted to issue $50,000 in capital stock the proceeds to be used for improvements and betterments to the plant. It is proposed to purchase a 500-kw Westinghouse, two-phase, 2300 volt, 60-cycle turbo-generator set and a 500-hp Babcock & Wilcox water-tube boiler. The two turbines installed some time ago were found to be defective and were returned to the builders, and the present belted unit from which all the load is supplied is overloaded. The condensing equipment installed for the first two turbines will be retained and used with the new turbine. The station is located near a small river so that condensing water is easily procurable, but inasmuch as coal costs only 70 cents per ton delivered in the bin it is doubtful if any marked financial economy will result.

Business Notes.

THE SCHUTTE & KOERTING COMPANY, of Philadelphia, Pa., manufacturer of steam and engineering specialties for power plant, chemical and other industries, has opened a branch sales office in the Keenan Building, Pittsburg, Pa., where it is represented by Mr. E. A. Knowlton.

INDIANAPOLIS BRANCH OF H. W. JOHNS-MANVILLE COMPANY.—The H. W. Johns-Manville Company, of New York, announces the opening of a branch office in Indianapolis, Ind., to take care of the local requirements of the trade in that territory. This office, which is located at 30 South Pennsylvania Street, Indianapolis, will be under the management of Mr. Charles E. Wehr, who for several years has represented the company in that section.

GEARS AND PINIONS.—The R. D. Nuttall Company, of Pittsburg, announces that it has added to its already comprehensive list of gears and pinions the well-known Titan brand of manganese steel gears and pinions, having arranged with the Atha Steel Casting Company for its exclusive sale. This places the Nuttall Company in a position to furnish practically everything in the way of gears and pinions for every requirement of action and electric railway service.

THE VANDERMAN PLUMBING & HEATING COMPANY, Willimantic, Conn., has discontinued the name under which the company was organized May 1, 1892, and is now known as the Vanderman Manufacturing Company. The officers, management and line of business continue the same as under the former name, with the exception that the plumbing and heating lines of the business are discontinued. Entire attention is now given to foundry business.

THE BRILLIANT TUNGSTEN LAMP FIXTURE.—Mr. Milton Hartman, well known in incandescent lamp circles, has taken the sales management of the tungsten lamp fixture department of the Brilliant Electric Company. This is a new department being organized to push the new tungsten unit, consisting of an artistic nickel-plated fixture, equipped with Holophane reflectors and "Brilliant" tungsten lamps, which combination forms an artistic, harmonious lighting unit, and by reason of the high efficiency of tungsten lamps, the cost of operation is so low that the outfit pays for itself in a very short time. The Brilliant tungsten lamp fixture department will exploit this outfit throughout the country.

BISSELL COMPANY ESTABLISHES ILLUMINATION DEPARTMENT.—The F. Bissell Company, Toledo, Ohio, has recently installed a department of illumination, which will be in charge of R. W. Hiett, illuminating engineer. It will be the object of this department to give information as to proper distribution of lighting units so as to secure the best illumination both as to quality and cost. Anyone using light or selling electricity or doing wiring can economize for himself or for his client usually at no cost to himself by taking advantage of this department, which will give advice on plans for lighting layout or reply to requests for information of this department. Both will be given free of charge unless it is something special, the layout of which would require considerable time, when a charge would necessarily have to be made.

DYNAMO BRUSHES.—The Cutler-Hammer Mfg. Company, of Milwaukee, has just issued a 16-page pamphlet descriptive of its "Wirt Type" dynamo brush, designed for use with low-tension, direct-current motors and generators, alternating-current generators, plating dynamos, exciters, etc. The construction of the brush is fully described and illustrated in the pamphlet in question, which states that in designing a dynamo brush two conditions must be met in order to insure satisfactory operation. One of these is that the brush must be elastic so that it will make good contact with the commutator under slight pressure, disregard of this condition resulting in undue heating and rapid deterioration of both brush and commutator, due to friction. The second is that the brush must oppose a high resistance to the wasteful and destructive current generated when adjoining commutator bars are short circuited by the brush. The claim is made that the construction of the Wirt Type dynamo brush is such that these two necessary conditions are fully met. In addition to the purely descriptive matter and price list, the pamphlet contains information on the care of commutators and brushes, the importance of correct lap, etc.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 2, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

889,200. ELECTRICAL FUSE; Albert G. Charters and John G. Jones, Watford, England. App. filed June 21, 1907. A fuse wire is held between spring plungers, which separate with an abrupt movement when the fuse blows.

889,205. RAILWAY SIGNAL SYSTEM; Emory P. Cook, Oberlin, Pa. App. filed Aug. 30, 1907. Block signal system having sectionally energized track rails and means by which circuits are completed to alarm devices on the trains through different trucks of the engine. Includes means for actuating the switch points.

889,220. TROLLEY POLE; John C. Gay, Jordanville, N. Y. App. filed Oct. 21, 1907. The trolley pole is made with parallel rods movable laterally so that the wheel is capable of yielding laterally without deflection from a vertical plane.

889,240. PROTECTIVE SETTING FOR METALLIC BODIES IN CONCRETE; Roman T. Kanski, New York, N. Y. App. filed Sept. 28, 1907. A protective setting for metallic bodies such as bridge anchors, etc., which are buried in the earth so as to prevent them from electrolytic action. Makes use of an earthernware box of special construction.

889,264. TROLLEY CATCHER AND RETRIEVER; Robert Shields, South Boston, Mass. App. filed April 22, 1907. A spring reel for a trolley cord of the type having a normally tensioned spring drum, which is held against action by a detent. An abrupt movement of the pole trips the detent and causes the rewinding spring to act.

889,266. THIRD-RAIL ATTACHMENT FOR ELECTRIC CARS; George Henry Sohn, Lincoln, Cal. App. filed Oct. 30, 1907. A conduit for street railways having a trolley wire supported by spaced saddles, which are in turn fastened to special spool-shaped insulators bolted between the guiding rails of the conduit slot.

889,277. ELECTRIC RAILWAY; Casimir Von Gizinsky and William McClure, Schenectady, N. Y. App. filed Dec. 19, 1906. Railway construction in which the third rail is forced in short sections, each of a length not exceeding the length of a motor car. The sections are brought into action by depressible tappets operating switches while the car passes.

889,305. REVERSING TIMER AND DISTRIBUTER; John Otto Heinze, Lowell, Mass. App. filed Nov. 30, 1906. Means for preventing pitting of the contacts of vibrating interrupters of induction coils. Makes use of a specially constructed circuit controller whereby there is a regular automatic reversal of the current flow through the vibrator.

889,308. PROCESS AND COMPOUND FOR TREATING MANTLES; Marcus H. Hulings, Allegheny, Pa. App. filed May 13, 1907. A compound for treating mantles to increase their life and capacity for incandescence and comprising a powder of common salt, lime, alum and borax.

889,322. LAMP RECEPTACLE; Andrew A. Moffitt, Providence, R. I. App. filed May 3, 1907. A lamp receptacle having a porcelain body adapted to receive a threaded shell and having a center contact formed of a metallic plate projecting straight in through one side wall from an exterior terminal.

889,346. EYE-MAGNET; Harold Thomassen, Dayton, Ohio. App. filed May 1, 1907. A U-shaped magnet, with converging poles of the ordinary form. Has an insulating plug attached thereto, by which the same is supported and manipulated in use.

889,355. THERMOSTAT; Peabody A. Brown, Denver, Col. App. filed Sept. 4, 1906. A means for regulating the temperature of liquids such as molten metal. Makes use of a thermostat device having circuits leading to an annunciator in the vicinity so that the temperature is indicated.

889,358. CUT-OUT MECHANISM FOR ELECTRICALLY OPERATED MACHINES; George S. Conger and Charles Pearce, New York, N. Y. App. filed Dec. 27, 1906. A cut-out for electrically operated machines designed to provide a simple and effective cut-out for stopping waste of electric current when the machine is temporarily out of use.

889,442. CABLE TERMINAL; Frank B. Cook, Chicago, Ill. App. filed Nov. 2, 1907. A cable terminal power distribution box designed to permit ready access without requiring a lineman to crawl through the drop wires when the terminal is mounted on a pole.

889,431. FURNACE FOR METALLURGICAL AND SMELTING PURPOSES; Kristian Birkeland, Lysaker, near Christiania, and Samuel Eyde, Christiania, Norway. App. filed Jan. 6, 1906. In an electric furnace, electrodes, means to produce an arc between the ends of the latter, a hearth adjacent the arc gap between the electrodes, but not immediately below the same, means to prevent material fed thereon from coming into contact with the arc ends of the electrodes and means to spread the arc over the hearth.

889,448. THIRD-RAIL ELECTRIC RAILWAY SYSTEM; John Francis Feeley, Bigtimber, Mont. App. filed July 16, 1907. Patentee has a trolley conductor supported on the inside of an overhanging insulating housing which is covered by a sheet metal coating to prevent wear.

889,463. TROLLEY WHEEL; Robert F. Heinze, Mamaroneck, N. Y. App. filed Aug. 30, 1907. The trolley harp is made very broad and the wheel pivoted between spring plungers so as to be capable of lateral movement independent of the harp.

889,469. SIGNALING SYSTEM FOR RAILWAYS; Charles H. Lay, Jersey City, N. J. App. filed Feb. 27, 1908. Overlap system for block signals adapted to provide greater flexibility than the usual danger and caution overlap system. Makes use of very short blocks and has four overlapping sections.

889,482. ELECTRIC SIGNALING SYSTEM; Francis L. O'Bryan, South Framingham, Mass. App. filed Jan. 8, 1908. Has a signal and a motor for actuating the same and a track relay for closing the motor circuit. Makes use of an electromagnet in the motor circuit having an armature adapted to break such circuit at the track relay after the signal has been actuated.

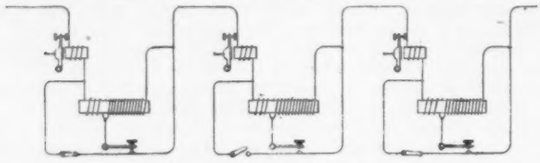
889,522. ELECTRIC INDUCTION FURNACE; Karl A. F. Hiorth, Christiania, Norway. App. filed Jan. 2, 1908. In an electric induction furnace, a spiral-like smelting channel, the ends of the windings of which are conductively connected to each other.

889,542. ELECTROMEDICAL BATTERY; Edmund T. Otto, Jersey City, N. J. App. filed Aug. 15, 1907. Complete electromedical apparatus, making use of a casing with a battery and induction coil and certain switches and parts adapted to be conveniently operated.

889,559. PROTECTOR FOR THIRD RAILS OF RAILWAY SYSTEMS; Joseph N. Tomlinson, of Vineland, N. J. App. filed Dec. 19, 1906. The third rail is made with an insulating coating, which extends over the top surface of the rail from one side so as to leave an undercut space, in which the collector shoe runs.

889,561. SIGNAL SYSTEM FOR RAILWAYS; Louis H. Thullen, Edgewood, Pa. App. filed March 3, 1906. A signal system having track rails, which are included in and form part of the return path of the conductor to the generator for the power current. Makes use of inductive bonds between the block sections.

889,566. ELECTRIC SWITCH; Alfred A. Wohlauer, New York, N. Y. App. filed June 25, 1907. An electric switch or cut-out, by which the spark of breaking contacts is confined in a vacuum tube, so that



889,592—Telegraph System.

danger of fire and the wearing out of the metallic parts is prevented. Makes use of a vacuum tube partly filled with mercury and mounted to turn between contacts in the switch casing.

889,567. SYSTEM OF ELECTRICAL DISTRIBUTION; Joseph Lester Woodbridge, Philadelphia, Pa. App. filed Oct. 2, 1907. Means for controlling the transfer of current between the circuits and transforming apparatus of a system of distribution, in which alternating and direct current circuits are interconnected by motor generators.

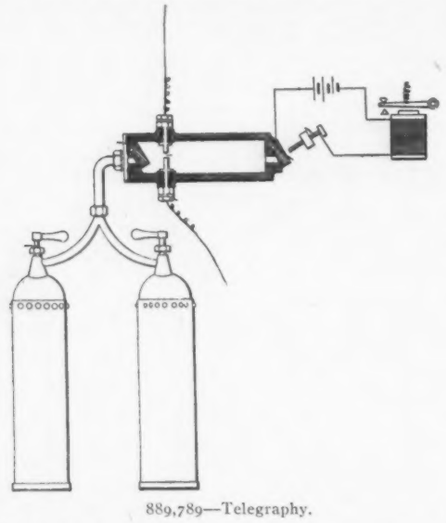
889,582. TELEPHONE SYSTEM; Henry P. Clausenm, Chicago, Ill. App. filed Nov. 15, 1908. Complete features of cord, signal and subscriber's circuits.

889,592. TELEGRAPH SYSTEM; Stephen Dudley Field, Stockbridge, Mass. App. filed Jan. 24, 1907. A means adapted for use on an ordinary telegraph line by which the usual sluggishness of the signals is overcome. Patentee makes use of a simple winding which is connected into the circuit at each station in such a way that a momentary e.m.f. is applied to the line at the beginning and termination of the signals so as to sharpen the same and therefore accelerate the transmission.

889,690. FIRE-TRUCK SIGNAL; John Kenlon, New York, N. Y. App. filed Aug. 22, 1907. A construction of fire truck signal designed to facilitate the control of the truck by the driver and tillerman. Has a signal apparatus to indicate to each party when the other is seated.

889,712. PRESSURE GOVERNOR; William McClave, Scranton, Pa. App. filed March 13, 1906. A pressure governor designed to control the condition of combustion within a furnace and govern the pressure of steam within a boiler heated by said furnace.

889,715. TROLLEY; Earl D. Peerstone, Chicago, Ill. App. filed Dec. 7, 1907. In place of the usual trolley wheel patentee has a frame with



889,789—Telegraphy.

a pair of swiveled harps which are spring-connected together and which have separate trolley wheels to engage the wire.

889,744. PLATING APPARATUS; Clarence G. Backus, New York, N. Y. App. filed Aug. 15, 1907. Has an electrolytic bath and an endless member movable relatively therein and means for adjusting the tension of said endless member. Includes a receptacle adapted to be connected with said endless member and partially submerged within said bath.

889,760. SWITCH BUTTON; Charles A. Clarke, Hartford, Conn. App. filed Oct. 24, 1907. A turnbutton switch so constructed that there will be practically no liability of relative rotation between the button and its contained parts arranged for attachment to a spindle of the like.

889,765. THERMAL ELECTRIC ALARM; Lloyd Currier, of Underwood, S. D. App. filed May 11, 1907. An alarm signal device of the type in which the circuit is closed by the action of a thermostat. Includes a lever having a ball at one end, engaging a socket in a heat-responsive member. The lever carries a circuit controlling device.

889,776. TROLLEY WIRE SPLICER; Harry G. Dyer, Gloucester City, N. J. App. filed Sept. 12, 1907. A quick trolley wire splicer having a sleeve with coned extremities and toothed ratchet bars, which are spring-impelled to grasp the wire within the sleeve.

889,784. TELEGRAPH SYSTEM; Charles Kinney Jones, Quincy, Ill. App. filed Sept. 12, 1907. Means for automatically cutting out any one or more of the telegraph keys in case the operator at a station forgets to close his line switch. Also sounds an alarm under these circumstances.

889,786. CONNECTOR FOR ELECTRIC WIRES; Charles J. G. Keiner, Baltimore, Md. App. filed Oct. 18, 1906. A connector for wires, making use of two interlocking members, which are bound together by a binding wire so as to avoid any possibility of the connection loosening from vibration.

889,788. ELECTRIC TRANSMISSION OF INTELLIGENCE; Isidor Kitsee, Philadelphia, Pa. App filed Oct. 28, 1905. A line of transmission, a series of transmitting and receiving stations for said line, the line comprising two conductors twisted in intimate relation, the stations in series between one of said conductors, in combination with terminals for said line, said terminals comprising twisted wires inductively related to, but conductively independent from, each other.

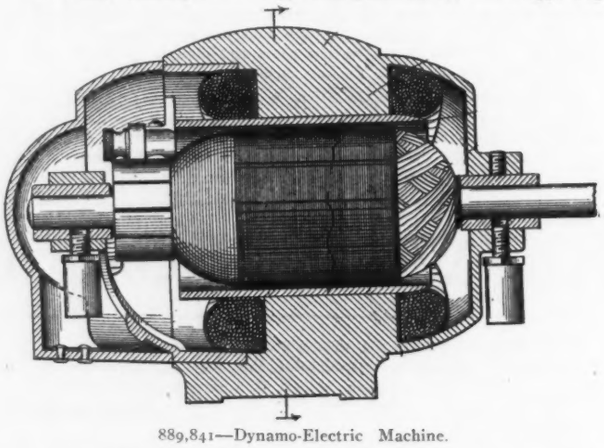
889,789. TELEGRAPH; Isidor Kitsee, Philadelphia, Pa. App. filed Nov. 9, 1906. The invention consists in producing explosions by means of incoming telegraphic impulses and operating a translating device through such explosions.

889,790. TELEGRAPHY Isidor Kitsee, Philadelphia, Pa. App. filed Nov. 17, 1906. A telegraph receiving device having two terminals and means to alternately join and separate said terminals independent of the action of the transmission means, said terminals being surrounded by an inflammable medium.

889,791. WIRELESS TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Dec. 21, 1906. Relates to modifications of the above.

889,792. TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Dec. 21, 1906. Has a detector, consisting of a series of metallic plates in loose contact with each other, part of said plates being provided with oxidized surfaces. One of the plates has a ground connection and the other has an antenna. Makes use of a recorder shunting all of said plates.

889,803. SUPPORT FOR ELECTRICAL CONDUCTORS; Francis B. H. Paine, Buffalo, N. Y. App. filed June 20, 1906. A supporting



889,841—Dynamo-Electric Machine.

system for high potential transmission lines designed to insure the double purpose of preventing the wire from falling to the ground and also grounding the wire on a supporting pole.

889,812. MULTIPLE SOCKET FOR ELECTRIC LAMPS; Frank J. Russell, New York, N. Y. App. filed Dec. 18, 1907. A multiple cluster socket, making use of stiff wires, being so bent as to produce the equivalent of threaded shells and center contacts.

889,841. DYNAMO-ELECTRIC MACHINE; Vincent G. Apple, Dayton, Ohio. App. filed May 11, 1907. Makes use of field pole cores and a continuously connecting pole tube of para-magnetic material, attenuated between the pole cores.

889,852. MEANS FOR AUTOMATICALLY INDICATING CERTAIN RELATIVE POSITIONS OF GUNS OR THE LIKE TO EACH OTHER; Willie Dickson Kilroy, of Hatch End, England. App. filed March 23, 1907. Means for preventing the different guns of a battleship from being simultaneously trained so that they might injure one another.

889,857. ELECTRIC FURNACE; Albert J. Petersen, Alby, Sweden. App. filed April 13, 1906. In an electric furnace for treating gases by means of voltaic arcs, the combination of a furnace chamber, an inner central electrode, an outer electrode concentric therewith, means around the furnace for creating a magnetic field in the space within the said outer electrode, and means for moving gases through the said furnace chamber, substantially as and for the purpose set forth.

889,871. SWITCH BUTTON; Charles A. Clarke, Hartford, Conn. App. filed Feb. 15, 1908. Construction of turnbutton switch designed to obtain proper adjustment between the button of the switch, and the face-plate or cover, and the spindle.

889,883. WIND-OPERATED DYNAMO; Emil J. Johnson, Madrid, Iowa. App. filed Aug. 31, 1907. A special construction of dynamo adapted to be directly mounted on the shaft of a windmill so as to be watertight in use and be properly balanced to swing with the wheel in every direction.

889,884. INSULATOR; M. Harrison Strong, of Ozark, Mo. App. filed June 9, 1906. An insulator making use of two grooved insulating rollers, which are strapped together in a metallic frame so as to receive the wire between them.

12,805. RUHMKORFF COIL; John McIntyre, Jersey City, N. J. App. filed Feb. 21, 1908. An induction coil designed to permit continuous running of the apparatus without requiring retrueing of the contact portions. Makes use of a retaining device independent of the vibrator and adapted to engage and hold the same temporarily while adjusting the operating mechanism of the coil.